

PATENT COOPERATION TREATY

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

Date of mailing (day/month/year) 12 October 2000 (12.10.00)		From the INTERNATIONAL BUREAU	
Applicant's or agent's file reference 49616		To: BERGGREN OY AB P.O. Box 16 FIN-00101 Helsinki FINLANDE	
International application No. PCT/FI00/00279	International filing date (day/month/year) 31 March 2000 (31.03.00)	Priority date (day/month/year) 01 April 1999 (01.04.99)	IMPORTANT NOTICE
Applicant NOKIA NETWORKS OY et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AG,AU,DZ,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CN,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,
GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,
NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
12 October 2000 (12.10.00) under No. WO 00/60801

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a **demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Continuation of Form PCT/IB/308

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF
THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

Date of mailing (day/month/year) 12 October 2000 (12.10.00)	IMPORTANT NOTICE
Applicant's or agent's file reference 49616	International application No. PCT/FI00/00279

The applicant is hereby notified that, at the time of establishment of this Notice, the time limit under Rule 46.1 for making amendments under Article 19 has not yet expired and the International Bureau had received neither such amendments nor a declaration that the applicant does not wish to make amendments.

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING
AMENDMENTS OF THE CLAIMS

(PCT Rule 62 and
Administrative Instructions, Section 417)

Date of mailing (day/month/year) 12 December 2000 (12.12.00)	in its capacity as International Preliminary Examining Authority
International application No. PCT/FI00/00279	International filing date (day/month/year) 31 March 2000 (31.03.00)
Applicant NOKIA NETWORKS OY et al	

To:

Swedish Patent Office
P.O. Box 5055
S-102 42 Stockholm
SUÈDE

The International Bureau hereby informs the International Preliminary Examining Authority that no amendments under Article 19 have been received by the International Bureau (Administrative Instructions, Section 417).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer F. Baechler Telephone No. (41-22) 338.83.38
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From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION
(PCT Rule 61.2)

Date of mailing (day/month/year) 12 December 2000 (12.12.00)	To: Commissioner US Department of Commerce United States Patent and Trademark Office, PCT 2011 South Clark Place Room CP2/5C24 Arlington, VA 22202 ETATS-UNIS D'AMERIQUE in its capacity as elected Office
International application No. PCT/FI00/00279	Applicant's or agent's file reference 49616
International filing date (day/month/year) 31 March 2000 (31.03.00)	Priority date (day/month/year) 01 April 1999 (01.04.99)
Applicant LAHTI, Harri et al	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

30 October 2000 (30.10.00)

in a notice effecting later election filed with the International Bureau on:

2. The election was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer F. Baechler Telephone No.: (41-22) 338.83.38
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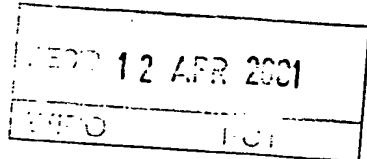
PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

14



Applicant's or agent's file reference 49616/SKU/PKK	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/FI00/00279	International filing date (day/month/year) 31.03.2000	Priority date (day/month/year) 01.04.1999	
International Patent Classification (IPC) or national classification and IPC7 H 04 L 1/22 // H 04 B 1/74			
Applicant Nokia Networks OY et al			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 30.10.2000	Date of completion of this report 20.03.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Åsa Hällgren/mj Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00279

I. Basis of the report

1. With regard to the **elements** of the international application:* the international application as originally filed the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

 the claims:

pages _____, as originally filed

pages _____, as amended (together with any statement) under article 19

pages _____, filed with the demand

pages _____, filed with the letter of _____

 the drawings:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

 the sequence listing part of the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

 the language of a translation furnished for the purposes of international search (under Rule 23.1(b)). the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing: contained in the international application in written form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form. The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. The amendments have resulted in the cancellation of: the description, pages _____ the claims, Nos. _____ the drawings, sheet/fig _____5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00279

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-11</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	<u>1-11</u>	YES
	Claims	_____	NO
Industrial applicability (IA)	Claims	<u>1-11</u>	YES
	Claims	_____	NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to a changeover method and arrangement for the clock signals of parallel transmission connections of a data transmission link. The aim of the invention is to solve the problem with earlier known bulky, cumbersome and power consuming analogue arrangements for changing clock signals. The problem is solved by using a specific changeover device, compensating for both the dynamic and static phase differences caused by the propagation of the signal in different transmission paths.

The international search has resulted in the following relevant documents:

D1: US 4349914 A

D2: US5740211 A

Document D1 refers to a bit synchronous switching system for space diversity operation.

Document D2 refers to a method and an apparatus for hitless switchover between redundant signals.

None of the aforementioned documents show a changeover method and an arrangement for clock signals in parallel transmission connections of a data transmission link, corresponding to the one claimed in claims 1-11 of the claimed invention.

Therefore, the invention claimed in claims 1-11 is considered to be novel and to include an inventive step.

PATENT COOPERATION TREATY

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 49616	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/FI 00/00279	International filing date (day/month/year) 31 March 2000	(Earliest) Priority Date (day/month/year) 1 April 1999
Applicant NOKIA NETWORKS OY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Certain claims were found unsearchable (See Box I).
2. Unity of invention is lacking (See Box II).
3. The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing
 - filed with the international application.
 - furnished by the applicant separately from the international application,
 - but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
 - transcribed by this Authority.
4. With regard to the title, the text is approved as submitted by the applicant.
 - the text has been established by this Authority to read as follows:
5. With regard to the abstract,
 - the text is approved as submitted by the applicant.
 - the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. The figure of the drawings to be published with the abstract is:
 - Figure No. 3 as suggested by the applicant.
 - because the applicant failed to suggest a figure.
 - because this figure better characterizes the invention.
 - None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00279

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 1/22 // H 04 B 1/74

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4349914 A (R. G. EVANS), 14 Sept 1982 (14.09.82), column 1, line 38 - column 2, line 24, claim 1, abstract --	1-11
A	US 5740211 A (P.S. BEDROSIAN), 14 April 1998 (14.04.98), column 1, line 64 - column 2, line 38, abstract -- -----	1-11

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

23 August 2000

17-10-2000

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. + 46 8 666 02 86

Authorized officer

Bo Gustavsson/AE
Telephone No. + 46 8 782 25 00

CORRECTED

INTERNATIONAL SEARCH REPORT
Information on patent family members

08/05/00

International application No.

PCT/FI 00/00279

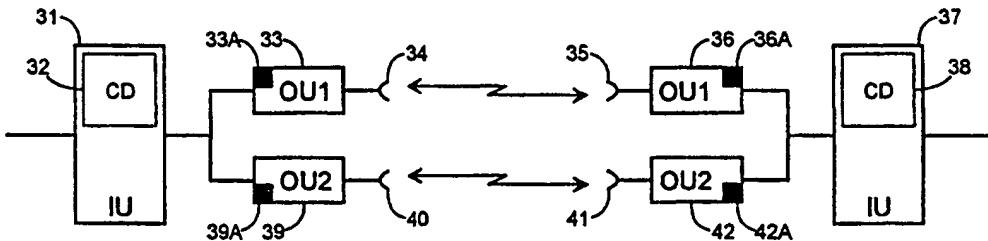
Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4349914 A	14/09/82	NONE	
US 5740211 A	14/04/98	EP 0841834 A JP 10261944 A	13/05/98 29/09/98



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : H04L 1/22 // H04B 131/74		A1	(11) International Publication Number: WO 00/60801 (43) International Publication Date: 12 October 2000 (12.10.00)
(21) International Application Number: PCT/FI00/00279			(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: 31 March 2000 (31.03.00)			
(30) Priority Data: 990738 1 April 1999 (01.04.99)	FI		
(71) Applicant (for all designated States except US): NOKIA NETWORKS OY [FI/FI]; P.O. Box 300, FIN-00045 Nokia Group (FI).			
(72) Inventors; and			
(75) Inventors/Applicants (for US only): LAHTI, Harri [FI/FI]; Hevontie 25 B, FIN-01820 Klaaukkala (FI). TORVINEN, Marko [FI/FI]; Kilonpuistonkatu 3 A 16, FIN-02610 Espoo (FI).			
(74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).			

(54) Title: METHOD AND ARRANGEMENT FOR CHANGING PARALLEL CLOCK SIGNALS IN A DIGITAL DATA TRANSMISSION



(57) Abstract

A novel changeover arrangement for the clock signals of parallel transmission connections of an assured data transmission link. According to the method of the invention, the transmission path to be received is changed, prior to losing the phase lock, and the data transmission of the link remains free of errors, in case even one of the transmission paths transmits the clock signal as sufficiently free of errors, even if errors occur in the other. This is realised by sending for the transmission paths a clock signal by parallel outdoor units (OU) located in succession to a common indoor unit (IU), by receiving said clock signal by a corresponding set of second outdoor units, where phase locked signals are used for locking to the signal, whereafter a second indoor unit receives information of the mode of the phase lock, as well as by selecting in the receiving indoor unit, on the basis of the mode information obtained from the outdoor unit, a transmission path that has less errors, in case errors are caused in the employed connection. Here also a fading of the clock signal, leading to a disconnection from the phase lock, is considered as an error.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
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DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

-Method and arrangement for changing parallel clock signals in a digital data transmission

5 The invention relates to a method and arrangement for changing parallel clock signals in the propagation assurance of digital data transmission, particularly for realising the propagation assurance of radio links. The invention is suited to other data transmission connections as well, for instance to connections using optical transmission paths.

10 The quality requirements for a digital radio link are generally known; said requirements are set for example by the ITU, International Telecommunication Union. The quality requirements refer to the reliability and interference-free quality of the transmission. The most important features are usability, error ratio and phase noise. Among the factors that affect the fulfilment of said criteria are hardware malfunctions, weather and changes in the signal path. In order to fulfil 15 the requirements, it is necessary to provide an equipment and propagation assurance for the radio link, which means the use of alternative equipment and transmission paths. By means of equipment assurance, there is obtained a more reliable usability, and by propagation assurance, there is obtained both a lower error ratio and a lower phase noise.

20 Figure 1 is a block diagram illustrating one target of propagation assurance. A public switched telephone network (PSTN) 11 is connected by wires to a mobile switching centre (MSC) 12. The security of the radio link between the switching centre 12 and the base station controller (BSC) 13 is extremely important, wherefore it is generally assured. The controller 13 is further connected, by radio connections which can also be backed up, to base telecommunication stations (BTS) 14, 16, 18 and to their antennas 15, 17, 19.

The propagation assurance of radio links is realised by means of one or several parallel radio connections. Now in parallel with the major radio connection, there is constructed one or several other backup transmission paths that carry the same information. The transmission paths are preferably different in order to prevent possible interference caused by the terrain and/or weather changes from affecting both paths at the same time. Among the transmission paths, there is selected the one that has, in the prevailing conditions, a better signal at the station receiving the radio link. The applied criterion for the selection is generally the signal strength,

5 but also the correctness of the parity of the received information. The changing of the transmission path is carried out by means of a specific changeover device, in a way that is as error-free as possible, by compensating both the dynamic and static phase differences caused by the propagation of the signals in different transmission paths. The block dealing with the clock signal is the most critical part in the changeover device.

10 Among the drawbacks with known analog arrangements for changing the clock signal are the required separate components; in order to be able to use them, there is needed space on the circuit board and they consume a remarkable amount of power.

15 Another drawback with known analog arrangements is their cumbersome tuning as a final step in the production.

20 The object of the invention is to introduce an advanced method and arrangement for changing the clock signals in parallel transmission connections of a assured data transmission link. According to the method of the invention, the receiving transmission path is changed prior to losing the phase lock, and the data transmission of the link remains error-free, in case at least one of the transmission paths transmits the clock signal as sufficiently free of errors, even if errors should occur in another path.

25 This is realised so that through the parallel outdoor units (OU), located in succession to the common indoor unit (IU), there is sent a clock signal to the transmission paths, said clock signal is received by a second set of outdoor units, where the signal is locked by phase locked loops, and information of the mode of the phase lock is transmitted to the second indoor unit; further, there is chosen, in the receiving indoor unit, on the basis of the information obtained from the outdoor unit, a transmission path that contains less errors, in case errors occur with the employed connection. Here also a fading of the clock signal, leading to a disconnection from the phase lock, is considered as an error.

30 The invention relates to a method for changing parallel clock signals in digital data transmission. According to the invention, the changing of the clock signals is requested from the changeover device by a control signal based on a signal indicating an uncertainty in the locking, obtained from the phase locked loop; then there is expected a simultaneous signal pattern "11", i.e. an identical mode in order to get the signals in the same active part of the phase, as well as a turning in the

polarity of the signal phase difference, in order to obtain a situation where the signals have just recently been either in the same phase or in a phase shift of 180°, and after a delay DL, the clock signals are changed at a moment during which the clock signals in question are as near to phase coincidence as possible.

- 5 The invention relates to an indoor unit provided for digital data transmission and for changing the clock signal to be received among parallel clock signals of digital data transmission. According to the invention, the indoor unit includes an changeover device in order to receive and change a propagation assured clock signal on the basis of missing the locking.
- 10 The invention also relates to an outdoor unit provided for digital data transmission and for changing the parallel clock signals of digital data transmission. According to the invention, the outdoor unit includes a transmitter for transmitting the clock signal and respectively a receiver for receiving the clock signal, a phase lock synchronised with the received clock signal and further a signal output for indicating the mode of the synchronisation for the indoor unit.
- 15

The invention relates to an arrangement for changing parallel clock signals in digital data transmission, said arrangement comprising a first indoor unit for dividing the clock signals to be transmitted, antennas for transmitting and receiving parallel clock signals, and another indoor unit for selecting the clock signals to be received. According to the invention, it also comprises

- a first changeover device in the first indoor unit and a second changeover device in the second indoor unit in order to receive the propagation assured clock signal;
- in the transmission paths, a first and second outdoor unit in the transmitter transmitting the clock signal, and respectively in the receiver receiving the clock signal, as well as a phase lock which is synchronised with the received clock signal.

According to the invention, the changing of the transmission path is carried out always when the reception of the clock signal deteriorates to the extent that the loop that is phase locked to the clock signal does not keep in phase.

The changeover device can be realised with a fully application specific integrated circuit (ASIC).

An advantage of the invention is a shorter mean time between failure (MTBF) owing to a smaller number of components.

Preferred embodiments of the invention are set forth in the independent claims.

The invention is described in more detail below, with reference to the accompanying drawings, where

5 figure 1 is a block diagram illustrating a service environment according to the invention,

figure 2 is a flow diagram illustrating a method according to the invention,

10 figure 3 is a block diagram illustrating a link arrangement according to the invention,

figure 4 is a block diagram illustrating a known signal changeover device,

figure 5 is a block diagram illustrating a changeover device applying a clock signal multiplexer according to the invention,

15 figure 6 is a block diagram illustrating a clock signal multiplexer according to the invention,

figure 7 is a block diagram illustrating another clock signal multiplexer according to the invention, and

figure 8 is a block diagram illustrating a third clock signal multiplexer according to the invention.

20 Figure 1 was already dealt with above, in the description of the prior art.

The flow diagram of figure 2 illustrates the operation steps of a method according to the invention. The data flow to be transmitted is divided into two transmissions, and there is chosen a primary transmission path, i.e. a default path 21. The clock signal is transmitted, 22, through both transmission paths, for instance via a radio

25 connection. When receiving the clock signals, the operational reliability of the loop that is phase locked to the clock signal is detected, 23, on both transmission paths.

If the operational reliability of the phase locked loop is sufficient, the phase lock of the clock signal in the chosen transmission path is used, 26. If the operational reliability of the phase locked loop is not sufficient, 24, the chosen transmission

30 path of the clock signal is changed, 25, by changing over to the phase lock which is

locked in the clock signal of the other transmission path. However, the clock signal is transmitted through both transmission paths.

Figure 3 is a block diagram illustrating the essential elements of a link arrangement according to the invention. An indoor unit (IU) 31 comprises a changeover device

5 (CD) 32 for receiving propagation assured information. The first transmission path comprises an outdoor unit (OU) OU1 33, antennas 34, 35 and an outdoor unit OU1 36. On the right-hand side, there is shown an indoor unit IU 37 that is common for both transmission paths, and a changeover device CD 38 included in said indoor unit 37. The other transmission path comprises corresponding devices 39, 40, 41, 10 42. The selection of the transmission path for transmissions from left to right is carried out by the changeover device 38, and the selection of the transmission path for transmissions from right to left is carried out by the changeover device 32. The outdoor units 33, 36, 39, 42 comprise means 33A, 36A, 39A, 42A for creating and outputting the signal that indicates the mode of the synchronisation in the clock 15 signal reception.

Figure 4 illustrates a prior art changeover device where the pairs of two clock signals CLK and a data signals DATA are changed. The elements outlined by the dotted line 41 are realised by an application specific integrated circuit (ASIC), and they include the following parts: an elastic buffer ELASTIC BUFFER 1 receiving

20 the first signal pair CLK1, DATA1, an elastic buffer ELASTIC BUFFER 2 receiving the second signal pair CLK2, DATA2, a multiplexer REF MUX 44 of the reference clock signal, as well as a correlator and multiplexer CORR & MUX 47. Outside the integrated circuit, there are needed at least an analog low pass filter (LPF) 45 and a voltage controlled oscillator (VCO) 46. The difference in the write 25 and read addresses of the active buffer 42 or 43 is conducted, via the multiplexer REF MUX 44, to the filter 45 in order to control the voltage controlled oscillator 46.

The writing to buffers is synchronised with incoming clock signals CLK1, CLK2, and the reading is synchronised by the output signal CLK of the voltage controlled

30 oscillator 46, which signal is locked to the clock signal CLK1 or CLK2 of the active cable by the signal of the time difference between writing and reading the information, which signal is obtained from the buffer. The cable to be received is determined in the correlator 47, and there are created control signals CONTROL1, 2 for reading the buffers and a control signal CONTROL3 for controlling the 35 multiplexer.

Figure 5 represents a block diagram of a signal changeover device according to the invention in an application specific integrated circuit. The clock signals CLK1, CLK2 of the received signal pairs are conducted to the clock signal multiplexer CLK MUX 51, where the clock signal to be received is selected. Both the clock signals CLK1, CLK2 and the data signals DATA1, 2 are also conducted to the data frame decoding blocks 52, 53, where the signals are used to create for example the following signals: synchronising signal SYNC, bit error signal (BE), frame alignment alarm signal (FAA), and pseudo frame signal (PF), as well as the data signals DATADF1, DATADF2 decoded from the frames. The outdoor unit OU activates the PF signal while loosing the locking of the clock signal CLK1, CLK2 to be received. In that case the data signal to be transmitted is replaced by a predetermined frame structure. The PF signal is used to indicate, prior to the FAA signal, an error situation in the reception of the clock signal CLK1, CLK2 in the indoor unit, and the FAA signal is only activated on the basis of several alignment errors in received frames. Owing to the pseudo frame structure, the data transmission between the outdoor unit OU and the indoor unit IU can be kept in operation even if the outdoor unit does not receive a proper clock signal. The signals are conducted to the blocks of elastic buffers EB & CTRL 54, 55, where also the selected clock signal CLK to be received is conducted in order to synchronise the data. From the blocks 54, 55, the data signals D1, D2 are conducted, by the data signal multiplexer DATA MUX 56, as a signal D to the decoding block 57. In the decoding block 57, the multiplexer 56 is controlled by the signal SYNC.

Figure 6 illustrates a clock signal multiplexer according to a preferred embodiment of the invention, which multiplexer waits for a suitable clock signal phase in order to change the signals, whereafter the signals are changed. The block 61 detecting the signal pattern "11" sends an active signal when the value of both clock signals CLK1, CLK2 is one. The D-flip-flop circuits 62, 63, 64 form a phase shift sensitive coupling, the outputs whereof are conducted to the block 65 detecting the signal patterns "01" and "10". Owing to said coupling, the output of the block 65 is raised to value one after a period of one clock cycle of the clock signal CLK2 has passed from the moment when the polarity of the phase difference between the clock signals CLK1, CLK2 was changed. Thus the phase difference at the moment of a rise in the output of the block 65 is virtually non-existent or 180° . If the signals are cophasal, they can be exchanged almost without a phase shift after a short delay DL 66. The changing of the clock signals by the multiplexer 68 is controlled by the block 67 checking the criteria of the changeover operation, which block 67 receives

as input signals a control signal requesting the changeover, a signal indicating the clock signal pattern "11" and a signal indicating the shift in the clock signal phase and delayed by the delay DL. On the basis of said criteria it is known that the signals are cophasal and not in a phase shift of 180° . The purpose of the delay DL 5 is to ensure that the changing of the clock signals is carried out while the clock signals are, from the point of view of the system, in a static mode, i.e. in mode one. This prevents the creation of a disturbing voltage peak.

Figure 7 illustrates another clock signal changeover device according to the invention, which device comprises, in addition to the embodiment illustrated in figure 6, an analog phase-locked loop (APLL) 71 for synchronising the change, said loop multiplying the frequency of the second clock signal CLK2 by four. The output of the loop 71 is conducted to the block 67 that checks the changeover criteria. Owing to the use of the APLL, the delay DL illustrated in figure 6 is not needed here, because the changeover mode can be delayed by applying a later 10 phase of the signal that was multiplied by four in frequency.

The block 61 indicating the clock signal pattern "11" can be realised for example by an AND gate. The block 65 indicating the pattern "01" or "10" can be realised for instance by an XOR gate. The block 86 indicating the pattern "10" can be realised for example by an inverter plus an AND gate.

Figure 8 illustrates a third clock signal changeover device according to the invention, wherein the phase difference between the signals is detected while the prevailing time difference is no longer than the delay DL. When the clock signal CLK1 is a little bit ahead of the clock signal CLK2, the output mode of the D-flip-flops 81, 82 is transmitted as one, but when the phase difference in any case causes a delay DL 83, the output mode of the D-flip-flops 84, 85 is transmitted as zero. Now the signals are considered to be sufficiently accurately cophasal, and the phase detector 86 obtains as input the output signals of the D-flip-flops 82, 85 in modes one and zero, and gives as output the signal one. The analog phase locked loop 71, the block 67 for checking the changeover criteria and the multiplexer 68 20 are otherwise operated in similar fashion as in the case of figures 6 and 7, but the block 67 only takes into account the loop 71, the phase detector 86 and the control signals.

The respective elements in the above described drawings 6, 7 and 8 are referred to by the same numbers in order to better illustrate the situation.

Let us now observe an example of a propagation assured radio link according to the invention, where the applied error correction method is an RS (63, 59) algorithm.

With both transmission paths in the outdoor units OU1, OU2, there is calculated a check sum for a data flow of the length of the period under observation, by

5 multiplying the data RS (63, 59) to be checked by a primitive polynome. The check sum is added as a continuation to the data to be checked. Here the period of observation is 354 bits, i.e. 59 bytes, when one byte includes 6 bits. The length of the data frame formed by the payload information contained by said period plus the check sum is 378 bits, i.e. 63 bytes, of which the share of the check sum is 4 bytes.

10 Here the created data frames are transmitted via two different radio paths, which are susceptible to disturbances in ways that are as different as possible. Thus possible interference generally causes errors only in one transmission path at a time.

15 The received data frames are treated in receiving outdoor units OU1, OU2 by dividing the transmitted data frame by a generator polynome, so that a divisional remainder is obtained. The algorithm that locates errors uses said remainder for detecting errors. In addition to error detection, errors can also be corrected, in this case no more than two erroneous bytes. The maximum amount of bytes that can be corrected can be raised, by means of interleaving, up to eight bytes. The bytes are 20 corrected, and there is calculated an error sum that indicates how many errors the received data contained. In the outdoor units OU1, OU2 there is created a data frame that contains the corrected payload information and the error sum.

25 The indoor unit IU receives from both outdoor units OU1, OU2 a data frame, and the changeover device CD selects, on the basis of the error sum, a better transmission path for the payload information to be further conducted to the output cable.

30 The invention can be used for example for backing up the links in radio networks conforming to the plesiochronous digital hierarchy (PDH). In that case, for instance the frequencies of radio links in the GSM network fluctuate within the range 7 - 38 GHz, and even a reading as high as 58 GHz is possible. In this type of application, the payload signal is a data signal of the plesiochronous digital hierarchy (PDH), with a general velocity of 2 Mbit/s or an even multiple thereof, but it may also be at least 34 Mbit/s. The length of the link is something between a hundred metres up to as much as several tens of kilometres.

Here an active mode of the signal means that the signal criteria are fulfilled. Thus the signal mode is true or advantageously one. The signal modes can also be inverted, in which case instead of mode "11", there is observed mode "00". The term 'identical modes' refers, however, to modes "11" or "00", and 'un-identical modes' means modes "01" or "10".

5 The indoor unit and outdoor unit here refer to the symbolic position of the unit in the system, and it does not restrict the location of said unit in the interior or exterior of a building.

Then number of transmission paths can be two or more.

10 The invention is not restricted to the above described embodiments only, but many modifications are possible within the scope of the inventive idea defined in the appended claims.

Claims

1. A method for changing parallel clock signals in a digital data transmission, characterised in that

- the changing of the clock signals is requested (25) from the changeover device by a control signal, based on a signal indicating the unreliability of the locking of the clock signal reception, said signal being received (23) from a phase locked loop.

5 - the system waits (25) until the clock signals were in the same, predetermined mode,

10 - the system waits (25) until the polarity of the signal phase difference is inverted, in order to reach a situation where the signals would have just been either in the same phase or in a phase shift of 180°, and

- after a delay DL, the clock signals are changed (25), in which case the changeover takes place at a moment which is as close to a phase coincidence of the clock signals to be changed as possible.

15 2. A method according to claim 1, characterised in that

- the changing of the clock signals is requested (25) by a control signal (CONTROL) from the changeover device, which control signal is based on a signal indicating an unreliability of the locking, said signal being received (23) from a phase locked loop,

20 - in the block that detects identical modes of the clock signals, there is transmitted (25) a detection signal, when both clock signals (CLK1, CLK2) are in the same mode,

25 - there is formed (25), by a phase shift sensitive coupling, for the block that detects un-identical modes of the clock signals, a signal for indicating a change in the polarity of the phase difference,

- there is transmitted (25), in a delayed fashion, a signal indicating the change in the polarity of the phase difference for the block checking that the criteria for realising the changeover are fulfilled, when it is detected that the clock signals are in different modes,

- the multiplexer is regulated (25) to change the clock signals, when at least the control signal (CONTROL), the signal detecting identical modes of the clock signals and the signal indicating a change in the polarity of the phase difference to be delayed are active, to the mode indicated by the control signal (CONTROL).

5 3. An indoor unit (31, 37) for digital data transmission and for changing parallel clock signals in digital data transmission, characterised in that the indoor unit comprises a changeover device (38) for receiving and changing the clock signal on the basis of missing the locking of the clock signal reception.

10 4. An indoor unit according to claim 3, characterised in that the changeover device (38) is realised in an application specific integrated circuit and comprises

- a clock signal multiplexer (51) for selecting the clock signals (CLK1, CLK2) for the signal pairs to be received as the clock signal (CLK) to be received, by waiting for a suitable clock signal phase in order to change said signals and by then performing the changeover,

15 - at least two data frame decoding blocks (52, 53) where the clock signals (CLK1, CLK2) and the data signals (DATA1, DATA2) are formed into control signals and data signals (DATADF1, DATADF2) decoded from the frames,

20 - at least two elastic buffer and control blocks (54, 55) where by means of control signals and decoded data signals (DATADF1, DATADF2), there are formed data signals (D1, D2) that are synchronised by the clock signal (CLK) to be received,

- a data signal multiplexer (56) for selecting the data signal (D) to be received, by regulating by the control signal (SYNC), and

25 - a decoding block (57) in order to synchronise the received data signal (D) by means of the received clock signal (CLK) into a final data signal (DATA) and for controlling the data signal multiplexer (56) by means of the control signal (SYNC).

5. An indoor unit according to claim 3 or 4, characterised in that the indoor unit (31, 37) constitutes part of a radio link in a mobile telecommunications system.

30 6. An outdoor unit (33, 36) for digital data transmission and for changing parallel clock signals in digital data transmission, characterised in that said outdoor unit comprises a transmitter for transmitting the clock signal to be changed and respectively a receiver for receiving said clock signal, and a phase lock to be

synchronised with the received clock signal and further means (33A, 36A) for outputting a signal that indicates the mode of the synchronisation.

7. An outdoor unit according to claim 6, characterised in that the outdoor unit is part of a radio link in a mobile telecommunications system.

5 8. An arrangement for changing parallel clock signals in digital data transmission, said arrangement comprising a first indoor unit (31) for dividing the clock signals to be transmitted, antennas (34, 35, 40, 41) for transmitting and receiving parallel clock signals and a second indoor unit (37) for selecting the clock signals to be received, characterised in that said arrangement also comprises

10 - a first changeover device (32) in the first indoor unit (31) and a second changeover device (38) in the second indoor unit (37) for receiving the propagation assured clock signal, and

15 - a first (33) and second outdoor unit (36) provided with a transmitter for transmitting the clock signal to be changed and respectively a receiver for receiving the clock signal, and a phase lock synchronised with the received clock signal.

9. An arrangement according to claim 8, characterised in that the changeover device (38) is realised in an application specific integrated circuit and comprises

20 - a clock signal multiplexer (51) for selecting the clock signals (CLK1, CLK2) of the signal pairs to be received as the clock signal (CLK) to be received, by waiting for a suitable phase of the clock signals in order to change said signals and by performing the changeover,

- at least two data frame decoding blocks (52, 53), wherein of the clock signals (CLK1, CLK2) and of the data signals (DATA1, DATA2) there are formed the control signals and data signals (DATADF1, DATADF2) decoded from the frames,

25 - at least two elastic buffer and control blocks (54, 55), wherein by means of the control signals and decoded data signals (DATADF1, DATADF2), there are formed the data signals (D1, D2) to be synchronised by the clock signal (CLK) to be received,

30 - a data signal multiplexer (56) for selecting the data signal (D) to be received by controlling with the control signal (SYNC), and

- a decoding block (57) for synchronising the received data signal (D) by means of the received clock signal (CLK) as the final data signal (DATA) and for controlling the data signal multiplexer (56) by a control signal (SYNC).

5 10. An arrangement according to claim 9, characterised in that the control signals include the following signals: a synchronising signal SYNC, a bit error signal BE, a frame alignment alarm signal FAA and a pseudo frame signal PF.

11. An arrangement according to claim 9, characterised in that the clock signal multiplexer (51) comprises

10 - a block (61) for detecting un-identical modes of the clock signals, which block gives an active signal when both clock signals CLK1, CLK2 are in the same mode,

- D-flip-flop circuits (62, 63, 64), which form a phase shift sensitive coupling,

15 - a block (65) for detecting un-identical modes of the clock signals, whereto there are conducted the outputs from the phase shift sensitive coupling, and the output of said block (65) is raised, owing to said coupling, to the value one after a period of one cycle of the second clock signal CLK2 has passed from the moment when the polarity of the phase difference between the clock signals CLK1, CLK2 was changed,

- a delay circuit (66) for delaying the output signal from the block (65) that detects un-identical modes of the clock signals,

20 20. - a block (67) for checking the criteria for the clock signal changeover, in order to check the mode of the changeover request control signal, the output signal from the block (61) detecting identical modes of the clock signals, and the output signal from the delay block (66), and

25 - a multiplexer (68) for performing the clock signal changeover under the control of the block (67) that checks the criteria, when the phase difference between the clock signals is virtually non-existent.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00279

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 1/22 // H 04 B 131/74

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4349914 A (R. G. EVANS), 14 Sept 1982 (14.09.82), column 1, line 38 - column 2, line 24, claim 1, abstract --	1-11
A	US 5740211 A (P.S. BEDROSIAN), 14 April 1998 (14.04.98), column 1, line 64 - column 2, line 38, abstract -----	1-11

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier document but published on or after the international filing date	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search	Date of mailing of the international search report
23 August 2000	28-08-2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Bo Gustavsson/AE Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

08/05/00

International application No.
PCT/FI 00/00279

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 4349914 A	14/09/82	NONE		
US 5740211 A	14/04/98	EP 0841834 A JP 10261944 A		13/05/98 29/09/98

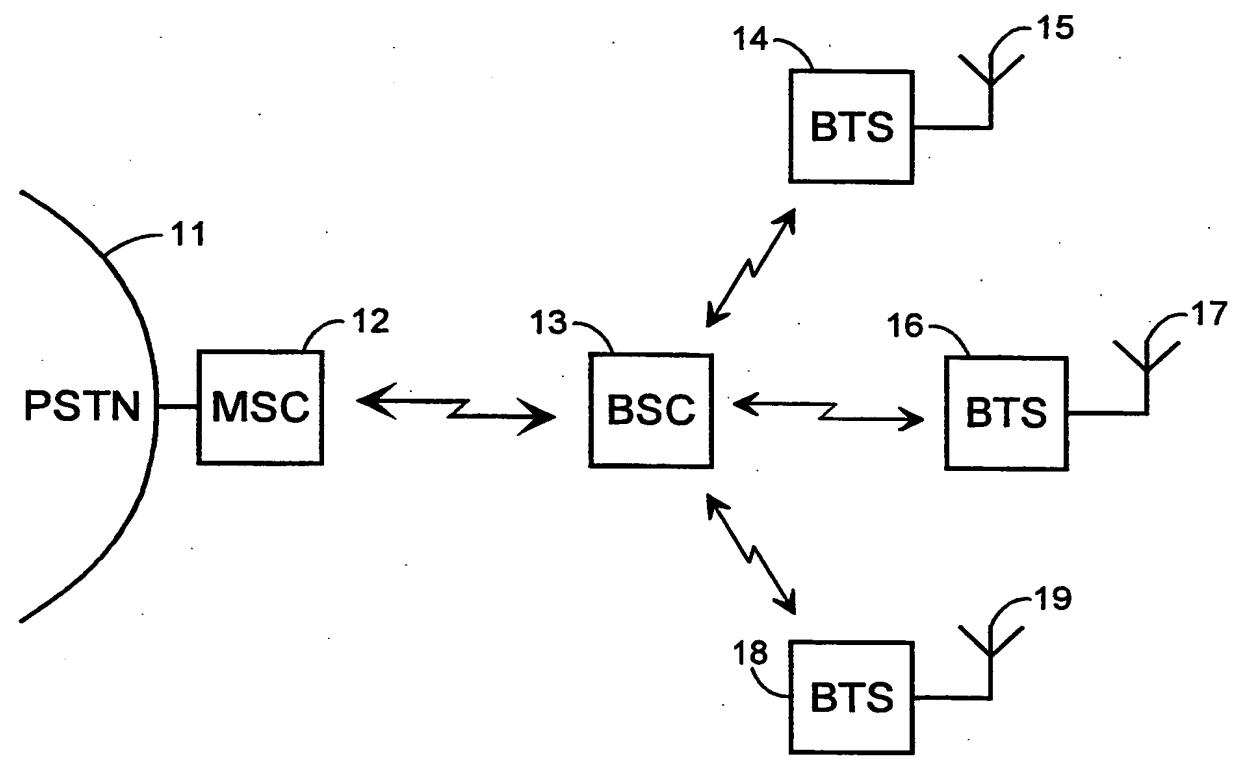


FIG. 1

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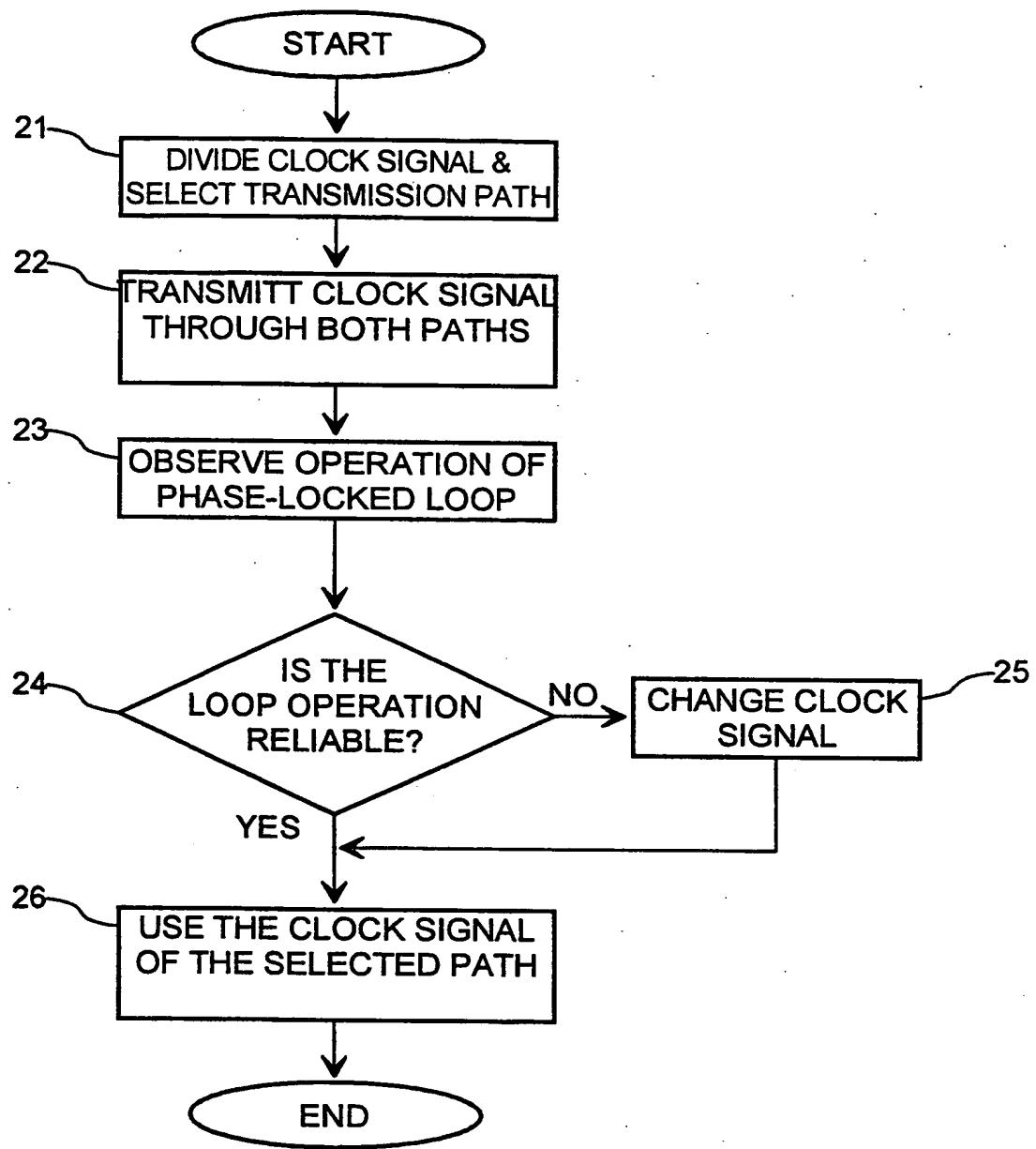
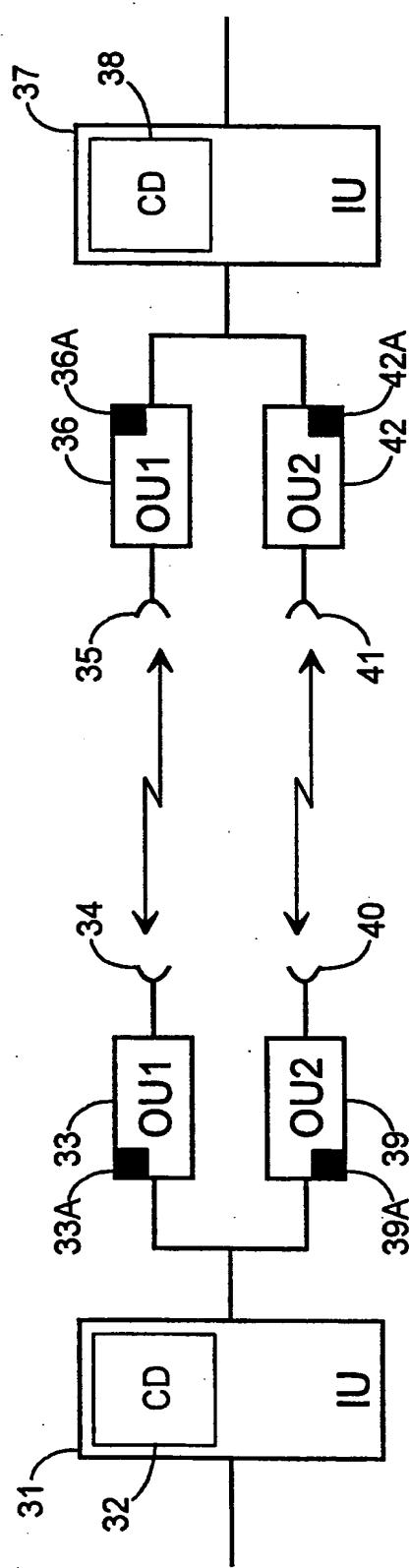


FIG. 2



3
FIG.

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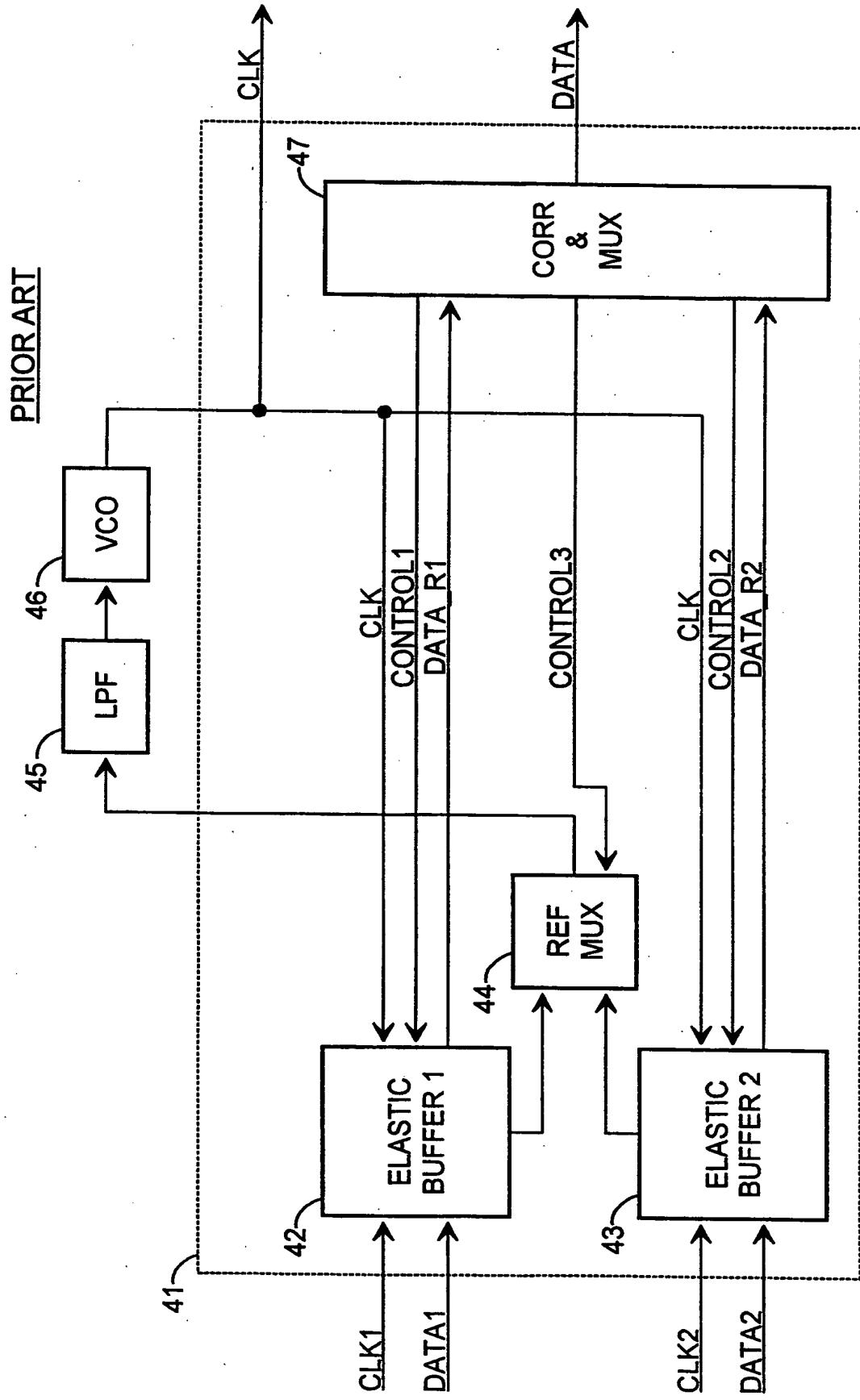
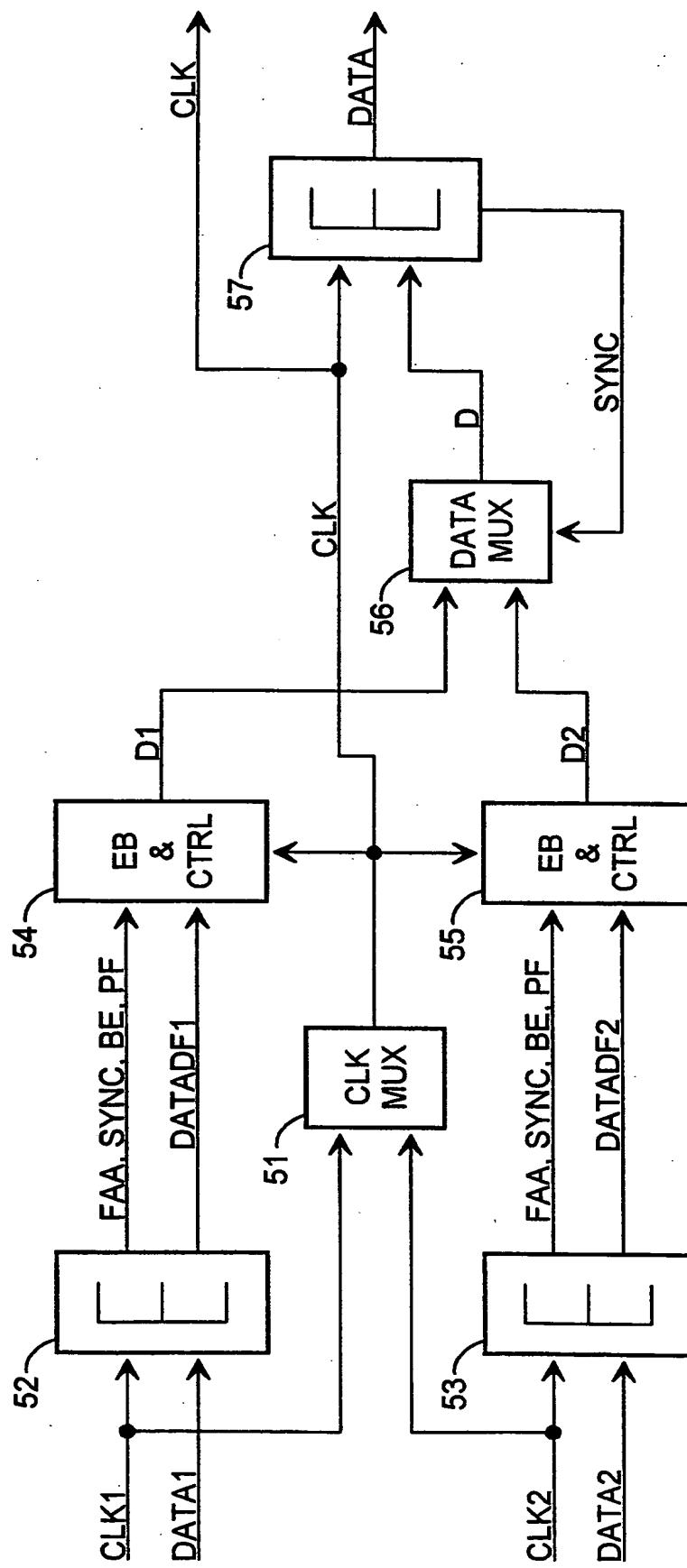


FIG. 4

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5
E/G

6/8

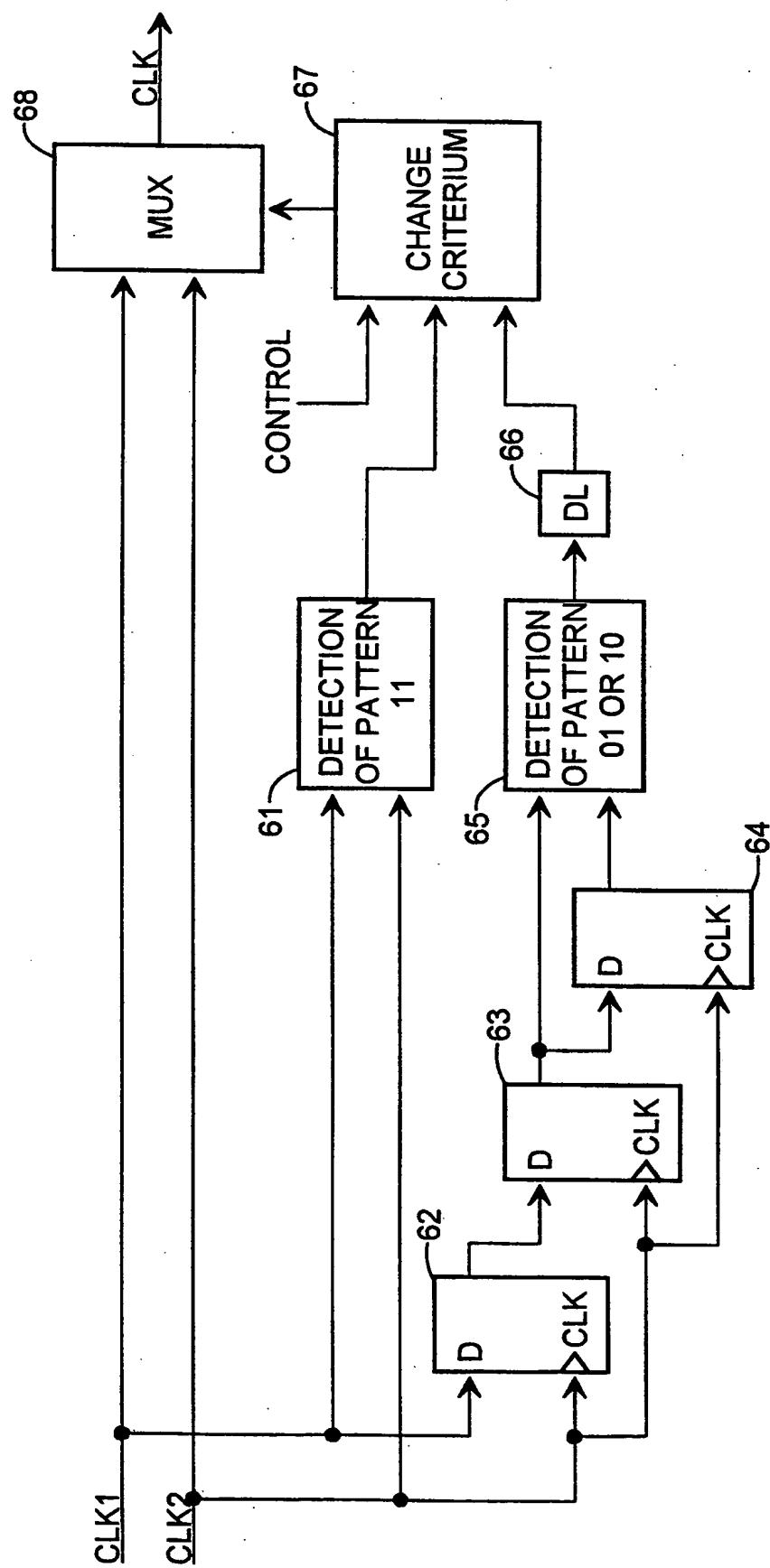


FIG. 6

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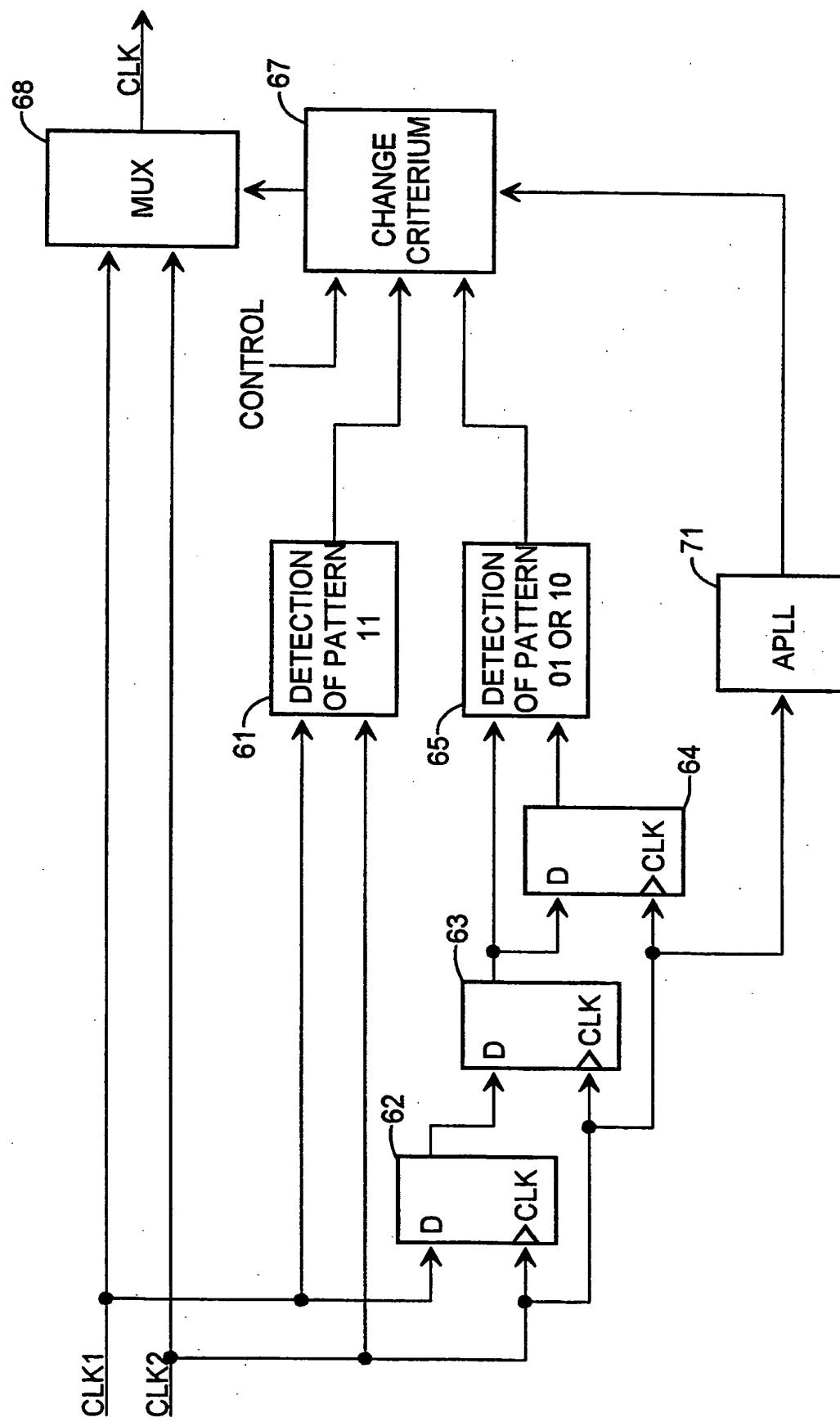


FIG. 7

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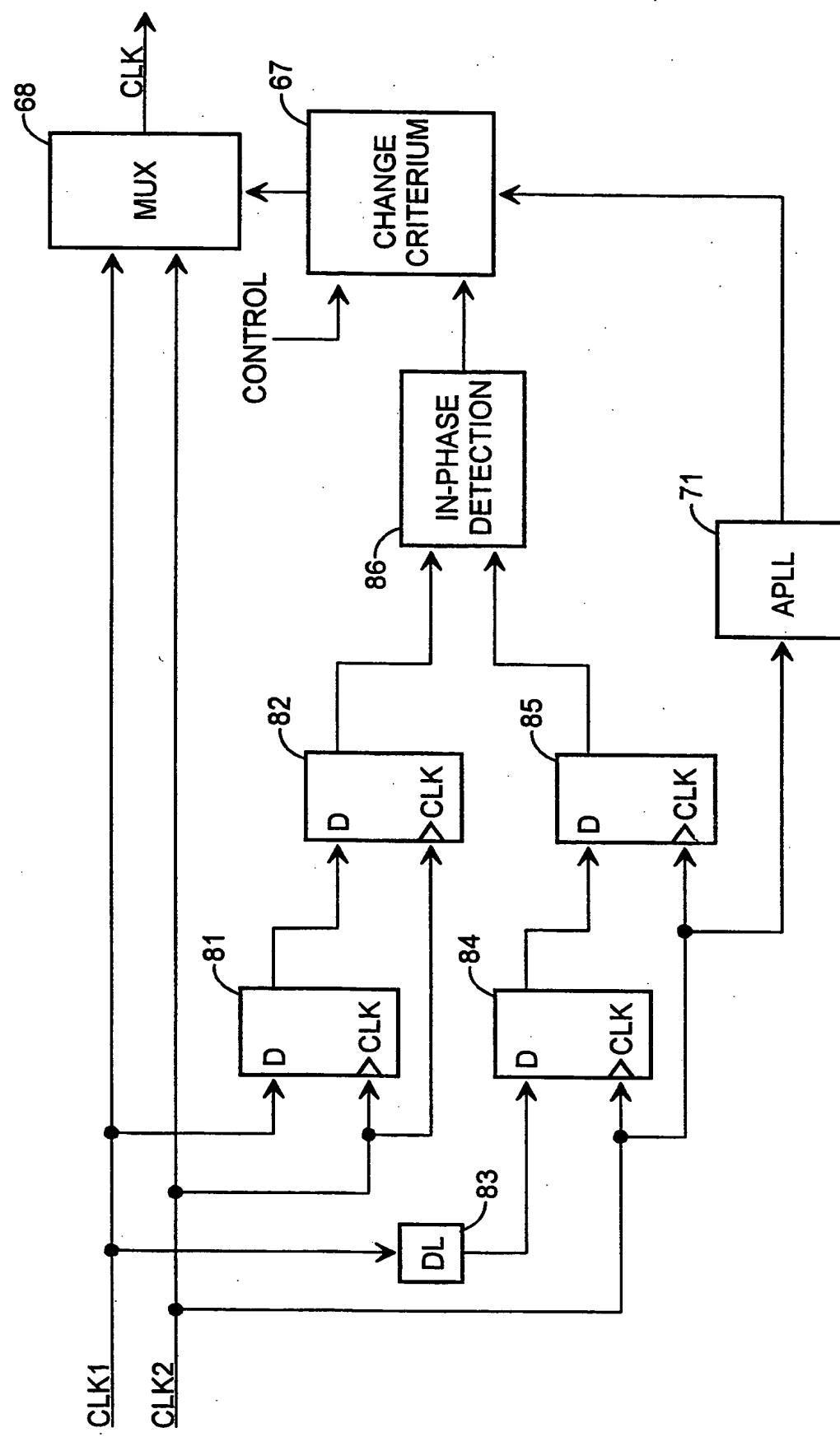


FIG. 8

IPEA/ SE

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA		Date of receipt of DEMAND
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		
International application No. PCT/FI00/00279	International filing date (day/month/year) 31 March 2000 (31.03.00)	Applicant's or agent's file reference 49616/SKU/PKK (Earliest) Priority date (day/month/year) 1 April 1999 (01.04.99)
Title of invention Method and arrangement for changing parallel clock signals in a digital data transmission		
Box No. II APPLICANT(S)		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) NOKIA NETWORKS OY P.O. Box 300, FIN-00045 NOKIA GROUP, Finland		Telephone No.: Facsimile No.: Teleprinter No.:
State (that is, country) of nationality: Finland		State (that is, country) of residence: Finland
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) LAHTI, Harri Hevontie 25 B, FIN-01820 KLAUKKALA, Finland		
State (that is, country) of nationality: Finland		State (that is, country) of residence: Finland
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) TORVINEN, Marko Kilonpuistonkatu 3 A 16, FIN-02610 ESPOO, Finland		
State (that is, country) of nationality: Finland		State (that is, country) of residence: Finland
<input type="checkbox"/> Further applicants are indicated on a continuation sheet.		

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCEThe following person is agent common representativeand has been appointed earlier and represents the applicant(s) also for international preliminary examination. is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked. is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*BERGGREN OY AB
P.O. Box 16, FIN-00101 HELSINKI, Finland

Telephone No.:

+358 9 693 701

Facsimile No.:

+358 9 693 3944

Teleprinter No.:

 Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments:***1. The applicant wishes the international preliminary examination to start on the basis of: the international application as originally filedthe description as originally filed as amended under Article 34the claims as originally filed as amended under Article 19 (together with any accompanying statement) as amended under Article 34the drawings as originally filed as amended under Article 342. The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)** Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.**Language for the purposes of international preliminary examination:** English..... which is the language in which the international application was filed. which is the language of a translation furnished for the purposes of international search. which is the language of publication of the international application. which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

1. translation of international application	:	sheets
2. amendments under Article 34	:	sheets
3. copy (or, where required, translation) of amendments under Article 19	:	sheets
4. copy (or, where required, translation) of statement under Article 19	:	sheets
5. letter	:	sheets
6. other (specify)	:	sheets

For International Preliminary Examining Authority use only

received	not received
<input type="checkbox"/>	<input type="checkbox"/>

The demand is also accompanied by the item(s) marked below:

1. <input checked="" type="checkbox"/> fee calculation sheet	4. <input type="checkbox"/> statement explaining lack of signature
2. <input type="checkbox"/> separate signed power of attorney	5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form
3. <input type="checkbox"/> copy of general power of attorney; reference number, if any:	6. <input type="checkbox"/> other (specify):

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

BERGGREN OY AB



Sirpa Kuisma
Patent Agent

HELSINKI, Finland 30 October 2000

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.

The applicant has been informed accordingly.

4. The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

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Demand received from IPEA on:

PCT

FEE CALCULATION SHEET

Annex to the Demand for international preliminary examination

International application No.	PCT/FI00/00279	For International Preliminary Examining Authority use only	
Applicant's or agent's file reference	49616/SKU/PKK	Date stamp of the IPEA	
Applicant NOKIA NETWORKS OY			
Calculation of prescribed fees			
1. Preliminary examination fee		SEK 4.200	P
2. Handling fee (<i>Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.</i>)		SEK 1.270	H
3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box		SEK 5.470	
		TOTAL	
Mode of Payment			
<input type="checkbox"/> authorization to charge deposit account with the IPEA (see below)		<input type="checkbox"/> cash	
<input type="checkbox"/> cheque		<input type="checkbox"/> revenue stamps	
<input type="checkbox"/> postal money order		<input type="checkbox"/> coupons	
<input checked="" type="checkbox"/> bank draft via SWIFT through account 5439-10-013-49		<input type="checkbox"/> other (<i>specify</i>):	

Deposit Account Authorization (*this mode of payment may not be available at all IPEAs*)

The IPEA/ SE is hereby authorized to charge the total fees indicated above to my deposit account.

(*this check-box may be marked only if the conditions for deposit accounts of the IPEA so permit*) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

Deposit Account Number

Date (day/month/year)

Signature

REVISED VERSION

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
12 October 2000 (12.10.2000)

PCT

(10) International Publication Number
WO 00/60801 A1

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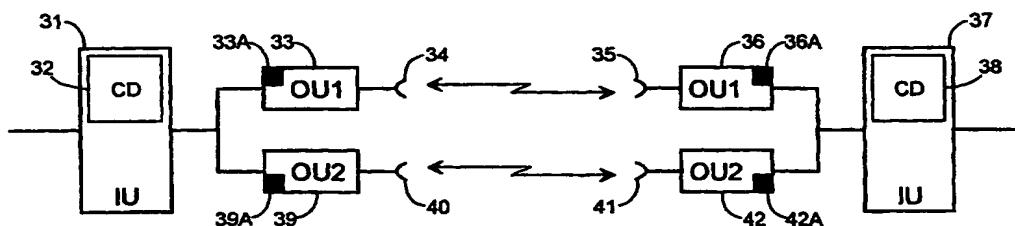
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(74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND ARRANGEMENT FOR CHANGING PARALLEL CLOCK SIGNALS IN A DIGITAL DATA TRANSMISSION



WO 00/60801 A1

(57) Abstract: A novel changeover arrangement for the clock signals of parallel transmission connections of an assured data transmission link. According to the method of the invention, the transmission path to be received is changed, prior to losing the phase lock, and the data transmission of the link remains free of errors, in case even one of the transmission paths transmits the clock signal as sufficiently free of errors, even if errors occur in the other. This is realised by sending for the transmission paths a clock signal by parallel outdoor units (OU) located in succession to a common indoor unit (IU), by receiving said clock signal by a corresponding set of second outdoor units, where phase locked signals are used for locking to the signal, whereafter a second indoor unit receives information of the mode of the phase lock, as well as by selecting in the receiving indoor unit, on the basis of the mode information obtained from the outdoor unit, a transmission path that has less errors, in case errors are caused in the employed connection. Here also a fading of the clock signal, leading to a disconnection from the phase lock, is considered as an error.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00279

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 1/22 // H 04 B 1/74

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4349914 A (R. G. EVANS), 14 Sept 1982 (14.09.82), column 1, line 38 - column 2, line 24, claim 1, abstract --	1-11
A	US 5740211 A (P.S. BEDROSIAN), 14 April 1998 (14.04.98), column 1, line 64 - column 2, line 38, abstract -- -----	1-11

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

23 August 2000

Date of mailing of the international search report

17-10-2000

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
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INTERNATIONAL SEARCH REPORT
Information on patent family members

08/05/00

International application No.
PCT/FI 00/00279

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 4349914 A	14/09/82	NONE		
US 5740211 A	14/04/98	EP 0841834 A JP 10261944 A		13/05/98 29/09/98

RECORD COPY

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PCT REQUEST

49616

Original (for SUBMISSION) - printed on 31.03.2000 08:55:55 AM

0-1	For receiving Office use only International Application No.	PCT/FI 00 / 00279
0-2	International Filing Date	31 MAR 2000 (31.03.00)
0-3	Name of receiving Office and "PCT International Application"	The Finnish Patent Office PCT International Application
0-4 0-4-1	Form - PCT/RO/101 PCT Request Prepared using	PCT-EASY Version 2.90 (updated 08.03.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	National Board of Patents and Registration (Finland) (RO/FI)
0-7	Applicant's or agent's file reference	49616
I	Title of invention	METHOD AND ARRANGEMENT FOR CHANGING PARALLEL CLOCK SIGNALS IN A DIGITAL DATA TRANSMISSION
II	Applicant This person is: II-1 II-2 II-4 II-5 II-6 II-7 II-8 II-9	applicant only all designated States except US NOKIA NETWORKS OY P.O. Box 300 FIN-00045 Nokia Group Finland FI FI +358-9-51121 +358-9-51168080
III-1	Applicant and/or inventor This person is: III-1-1 III-1-2 III-1-4 III-1-5 III-1-6 III-1-7	applicant and inventor US only LAHTI, Harri Hevontie 25 B FIN-01820 Klaaukkala Finland FI FI

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III-2	Applicant and/or inventor	
III-2-1	This person is:	
III-2-2	Applicant for	
III-2-4	Name (LAST, First)	
III-2-5	Address:	
III-2-6	State of nationality	
III-2-7	State of residence	
IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	
IV-1-1	Name	
IV-1-2	Address:	
IV-1-3	Telephone No.	
IV-1-4	Facsimile No.	
IV-1-5	e-mail	
V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	

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V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	Exclusion(s) from precautionary designations NONE	
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	01 April 1999 (01.04.1999)
VI-1-2	Number	990738
VI-1-3	Country	FI
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): VI-1	
VII-1	International Searching Authority Chosen Swedish Patent Office (ISA/SE)	
VIII	Check list	
VIII-1	Request	number of sheets 4 electronic file(s) attached -
VIII-2	Description	8 -
VIII-3	Claims	4 -
VIII-4	Abstract	1 49616.txt
VIII-5	Drawings	8 -
VIII-7	TOTAL	25
VIII-8	Accompanying items	
VIII-9	Fee calculation sheet	paper document(s) attached ✓ electronic file(s) attached -
VIII-10	Separate signed power of attorney	✓ -
VIII-16	Copy of general power of attorney	✓ -
VIII-16	PCT-EASY diskette	- diskette
VIII-18	Figure of the drawings which should accompany the abstract 3	
VIII-19	Language of filing of the international application Finnish	
IX-1	Signature of applicant or agent	
IX-1-1	Name	 BERGGREN OY AB
IX-1-2	Name of signatory	Joni Mikkola
IX-1-3	Capacity	Patent Agent

PCT REQUEST

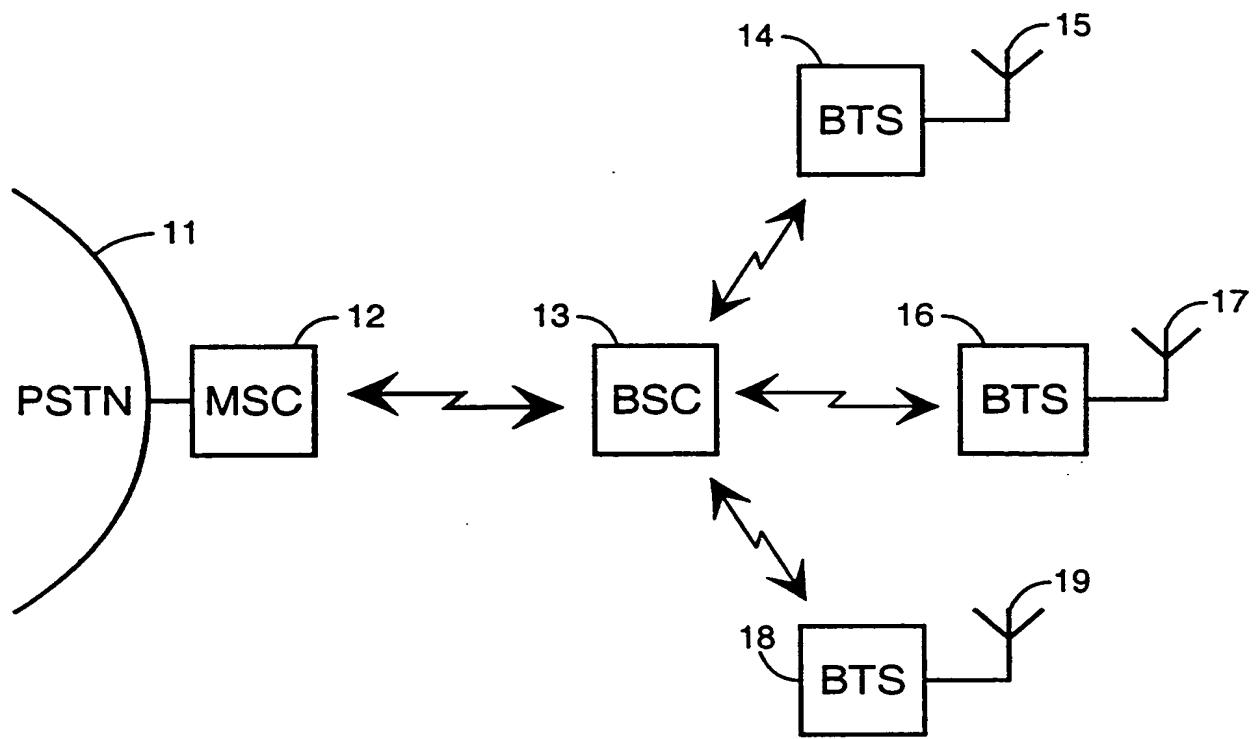
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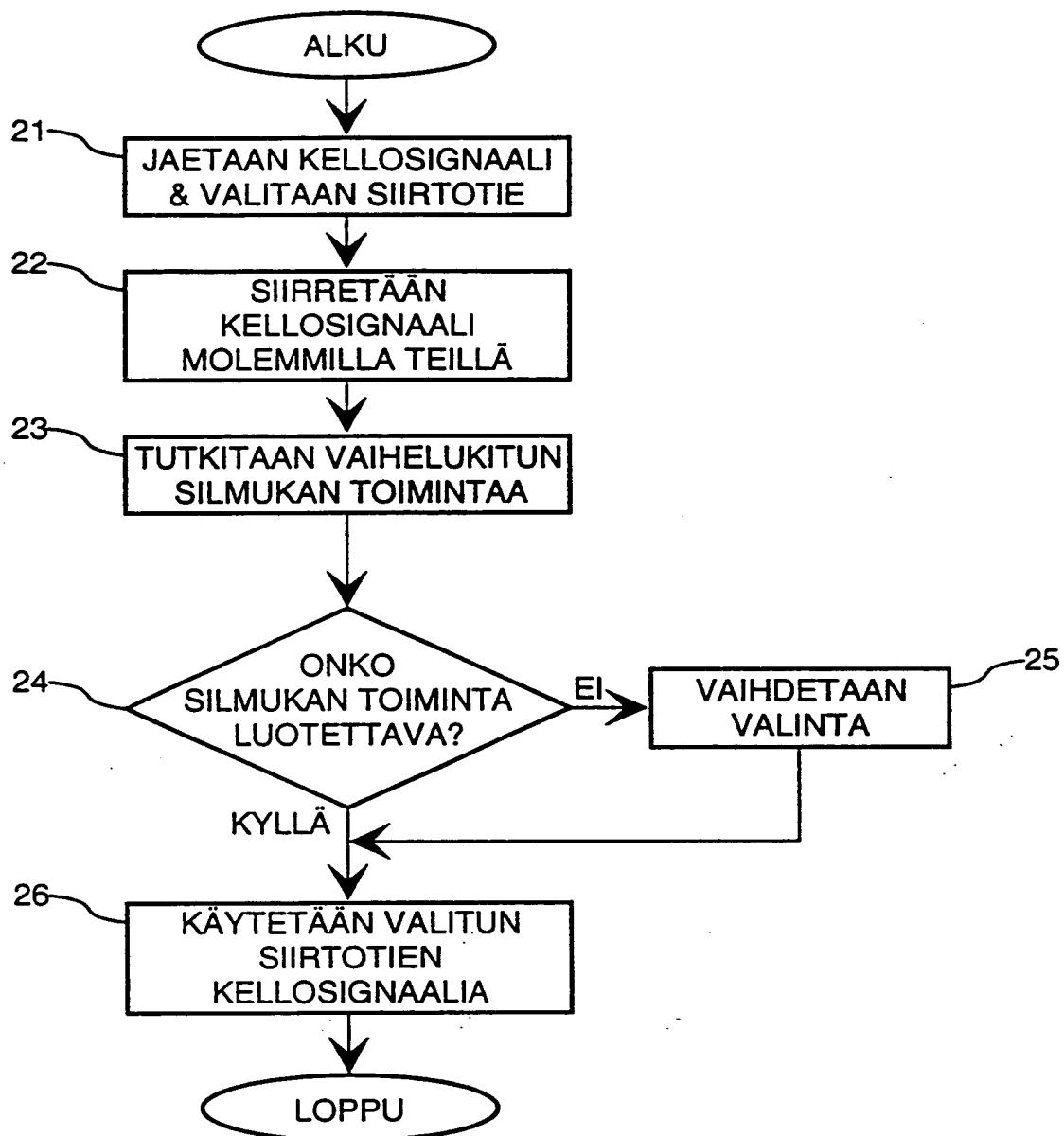
10-1	Date of actual receipt of the purported international application	31 MAR 2000 (31 -03- 2000)
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	

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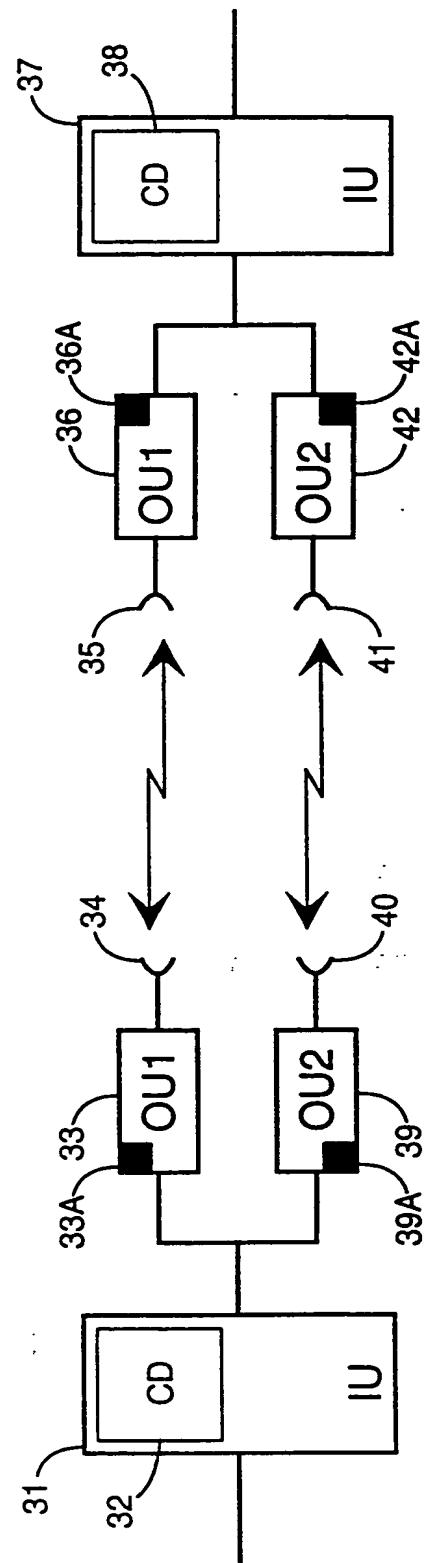
11-1	Date of receipt of the record copy by the International Bureau	01 MAY 2000 (01.05.00)
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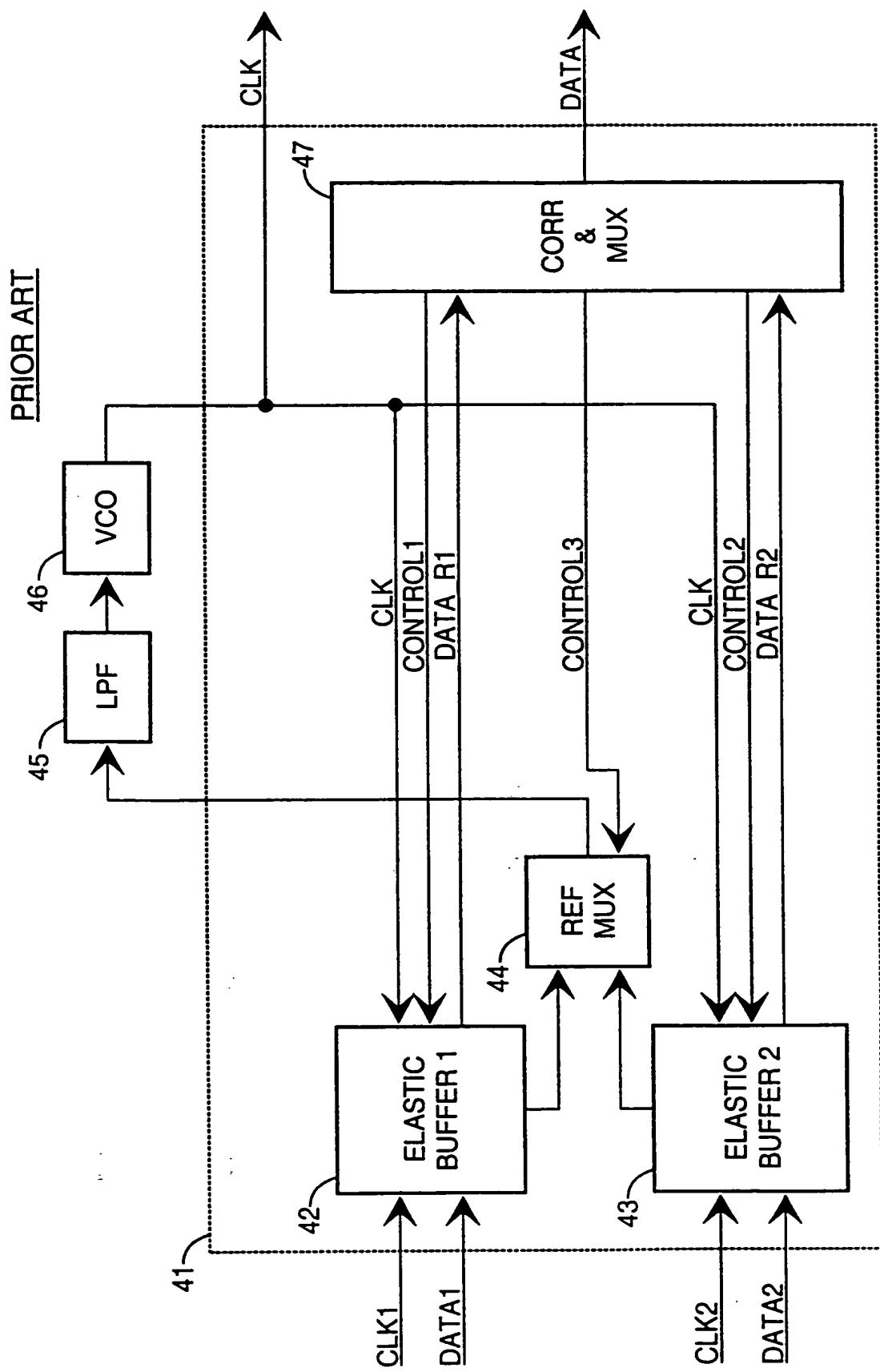
KUVIO 1



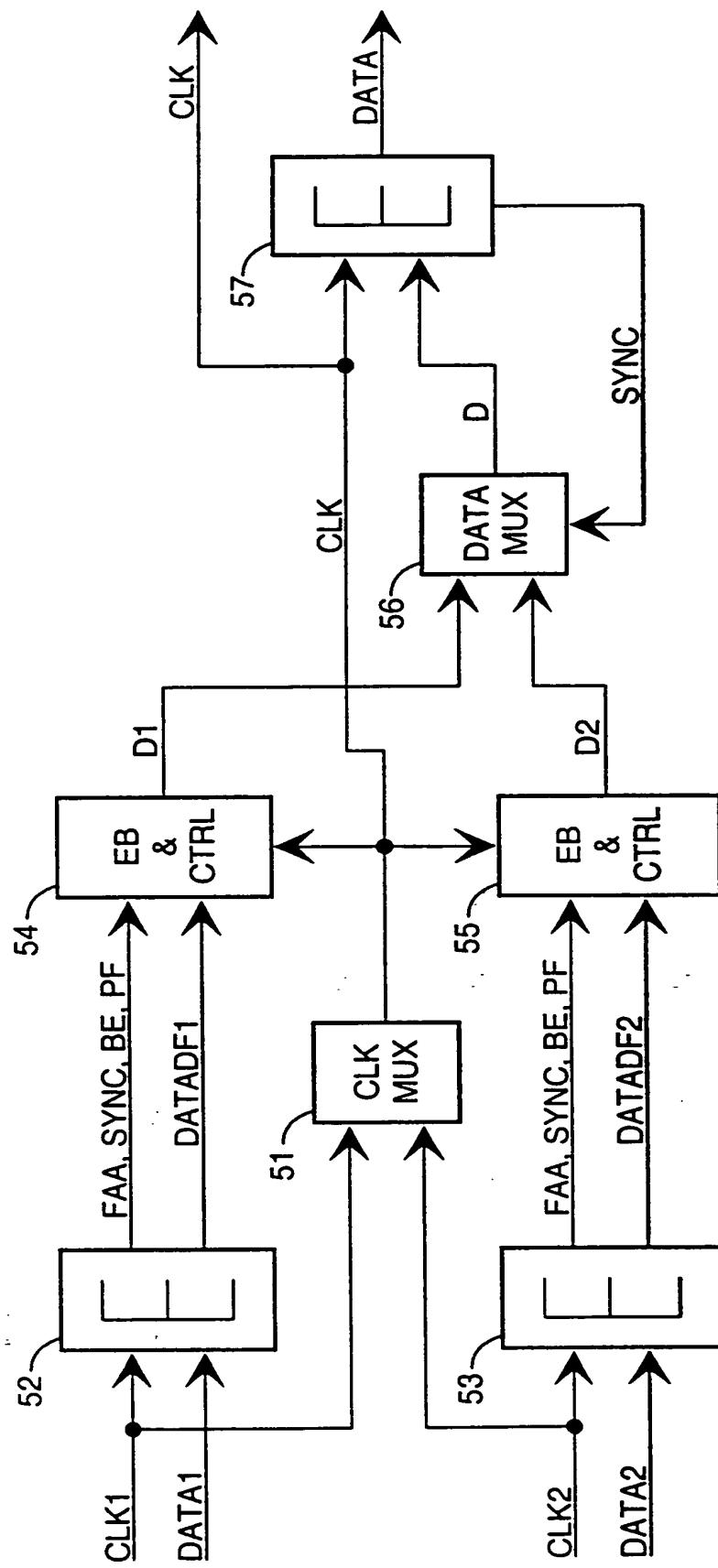
KUVIO 2



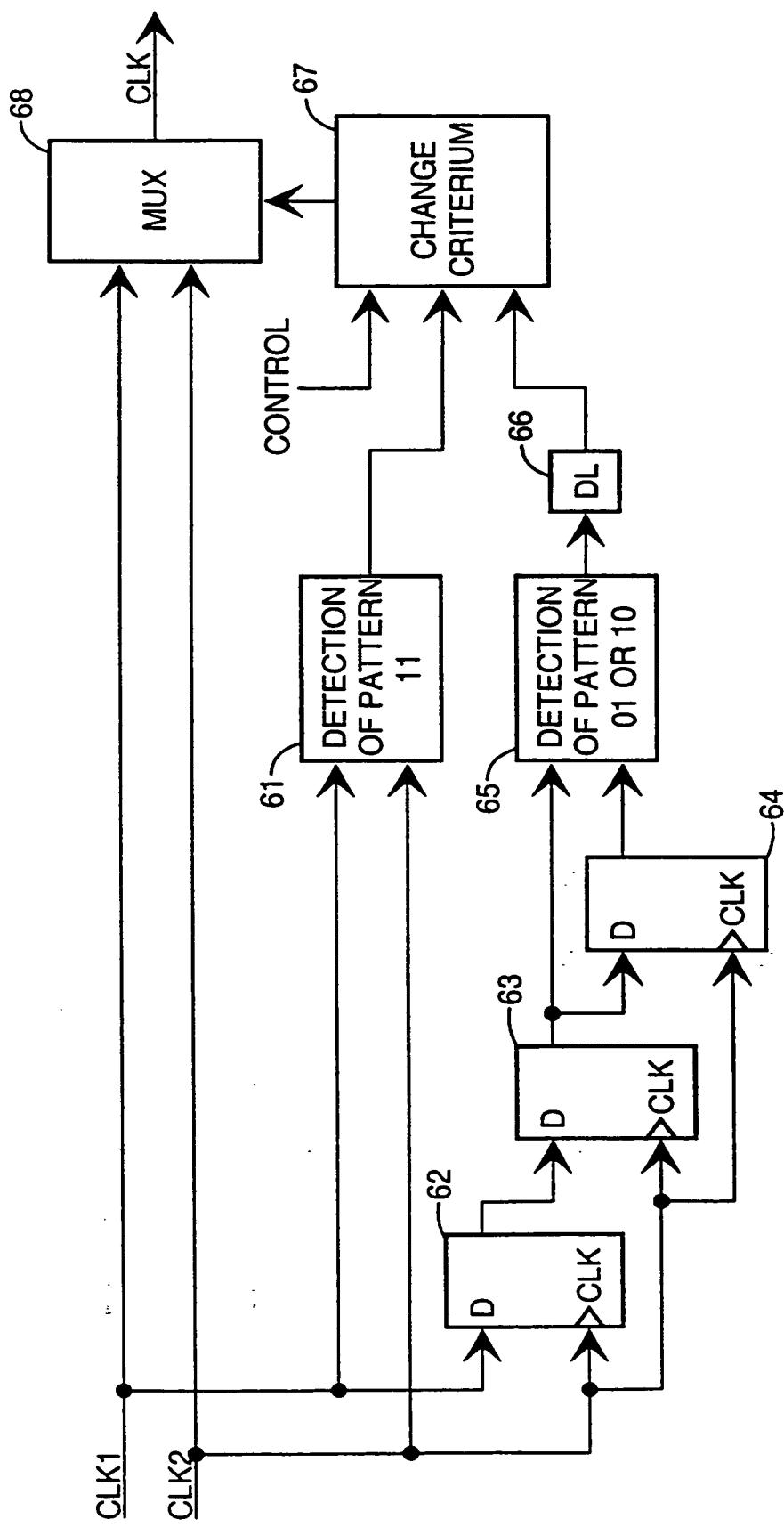
KUVIO 3



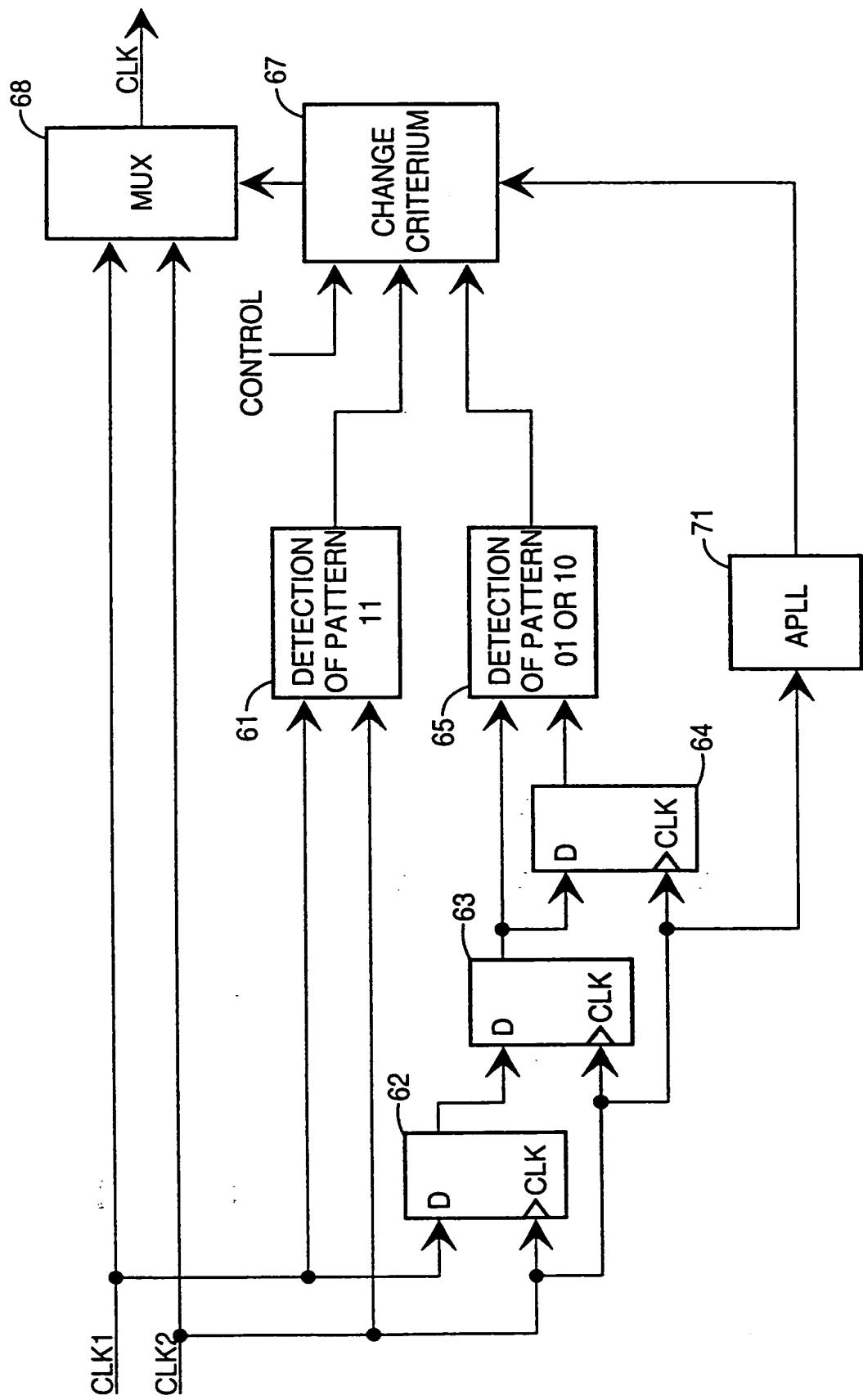
KUVIO 4



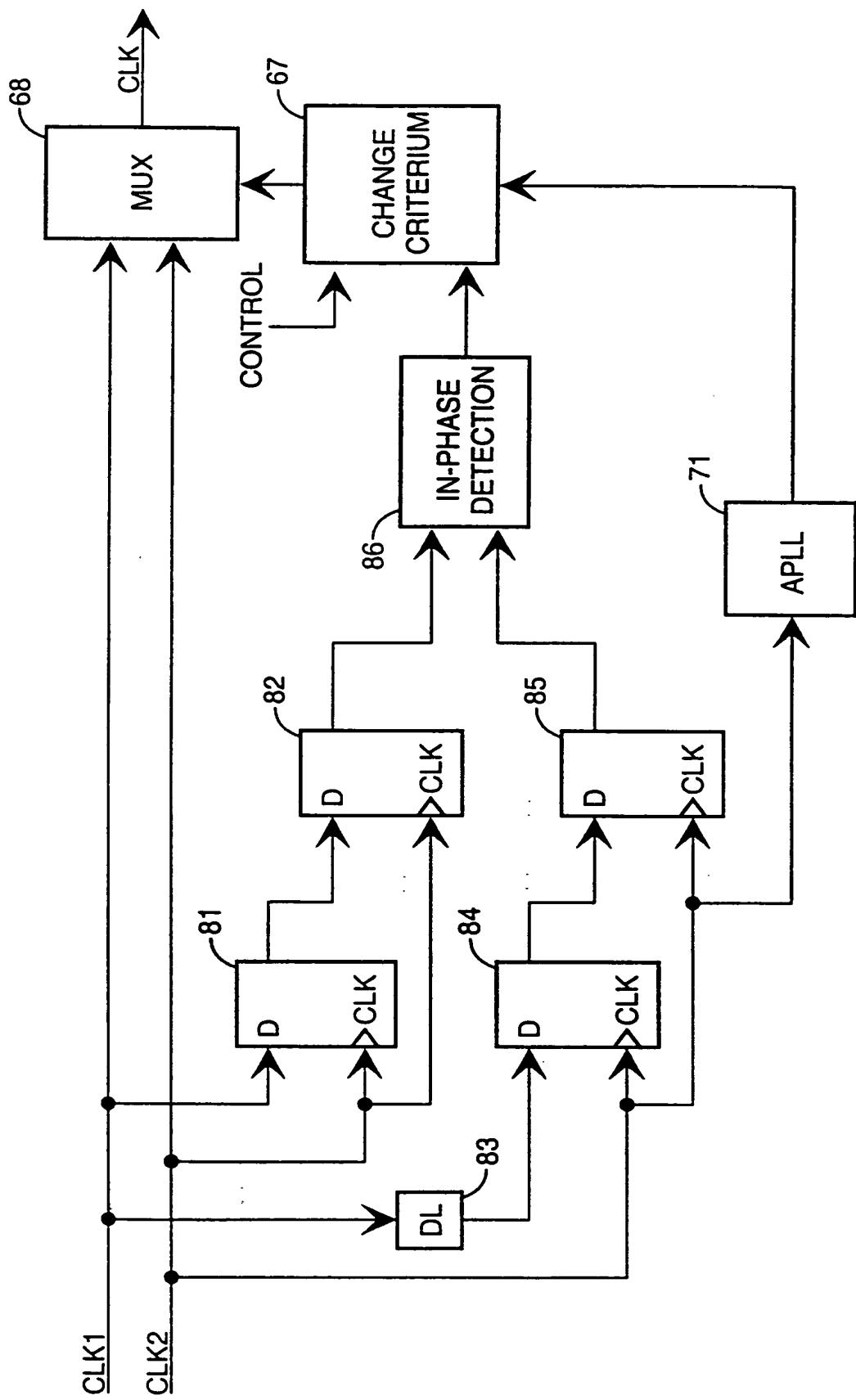
KUVIO 5



KUVIO 6



KUVIO 7



KUVIO 8

Menetelmä ja järjestely digitaalisen tiedonsiirron rinnakkaisten kellosignaalien vaihtamiseksi

Keksinnön kohteena on menetelmä ja järjestely digitaalisen tiedonsiirron etenemis-
5 varmennuksen rinnakkaisten kellosignaalien vaihtamiseksi erityisesti radiolinkkien etenemisvarmennuksen toteuttamista varten. Keksintö soveltuu myös muihin siirto-
yhteyksiin, esimerkiksi optista siirtotietä käyttäviin yhteyksiin.

Tunnetaan digitaalisen radiolinkin tiedonsiirron laatuvaatimukset, joita asettaa mm. kansainvälinen tietoliikenneliitto (ITU, International Telecommunication Union).
10 Laatuvaatimukset koskevat siirron varmuutta ja häiriöttömyyttä. Erityisesti on kyse käytettävyydestä, virhesuhteesta ja vaihekohinasta. Näiden kriteerien täyttämiseen vaikuttavat laitteiden vikaantumiset, säätila ja signaalin kulkutien muuttuminen. Vaatimusten täyttämiseksi tarvitaan radiolinkin laite- ja etenemisvarmennus, joilla tarkoitetaan vaihtoehtoisten laitteiden ja etenemisteiden käyttöä. Laitevarmennuksella saadaan varmempi käytettävyyys ja etenemisvarmennuksella saadaan sekä pienempi virhesuhde että pienempi vaihekohina.

Kuviossa 1 esitetään lohkokaaviona etenemisvarmennuksen yksi käytökkohde. Yleinen kytkentäinen puhelinverkko (PSTN, Public Switched Telephone Network) 11 on kytetty johdoin matkaviestinliikenteen kytkentäkeskukseen (MSC, Mobile Switching Centre) 12. Koska kytkentäkeskuksen 12 ja tukiasemien ohjaimen (BSC, Base Station Controller) 13 välinen radiolinkki on varmuudeltaan erittäin tärkeä, se yleensä varmennetaan. Ohjain 13 kytetään edelleen radioyhteyksillä, jotka ovat myös varmennettavissa, tukiasemiin (BTS, Base Telecommunication Station) 14, 16, 18 ja näiden antenneihin 15, 17, 19.

25 Radiolinkkien etenemisvarmennus toteutetaan yhdellä tai useammalla rinnakkaisella radioyhteydellä. Tällöin pääasialisen radioyhteyden rinnalle rakennetaan yksi tai useampi toinen saman informaation kuljettava varmentava siirtotie. Siirtotiet ovat mieluiten erilaiset, jotta mahdolliset maastosta ja/tai sään vaihteluita aiheutuvat häiriöt eivät kytkeytyisi molempien samanaikaisesti. Siirtoteistä valitaan radiolinkin 30 vastaanottavalla asemalla signaaliltaan parempi olosuhteiden mukaan. Valintakriteerinä käytetään yleensä signaalin voimakkuutta, mutta myös vastaanotetun tiedon pariteetin oikeellisuutta. Siirtotien vaihto suoritetaan erityisellä vaihtolaitteella mahdollisimman virheettömästi tasaamalla signaalien etenemisestä eri siirtoteillä aiheu-

tuva sekä staattinen että dynaaminen vaihe-ero. Kellosignaalia käsittelevä lohko on vaihtolaitteen kriittisin osa.

Ongelmana tunnetuissa analogisissa järjestelyissä kellosignaalin vaihtamiseksi ovat niiden edellyttämät erilliskomponentit, joiden käyttöä varten edellytetään tilaa piiri-levyllä ja jotka kuluttavat merkittävästi virtaa.

Edelleen ongelmana tunnetuissa analogisissa järjestelyissä on työläs viritys tuotanon lopuksi.

Keksinnön tarkoituksesta on esittää parempi varmennetun tiedonsiirtolinkin rinnakkaisen siirtoyhteyksien kellosignaalien vaihtojärjestely ja -laite. Keksinnön mukaisella tavalla vastaanotettava siirtotie vaihdetaan ennen vaihelukituksen menetystä ja linkin tiedonvälitys säilyy virheettömänä, mikäli edes yksi siirtoteistä välittää kellosignaalin riittävän virheettömänä, vaikka toisella aiheutuu virheitä.

Tämä toteutetaan lähettämällä siirtoteille yhteisen sisäyksikön (IU, Indoor Unit) jälkeisillä rinnakkaisilla ulkoikysiköillä (OU, Outdoor Unit) kellosignaali, vastaanottamalla se vastaavilla toisilla ulkoikysiköillä, joissa lukitutaan vaihelukituilla silmukoilla signaaliin ja annetaan toiselle sisäyksikölle tietoa vaiheen lukituksen tilasta, sekä valitsemalla vastaanottavassa sisäyksikössä ulkoikysiköstä annetun tilatiedon perusteella virheettömämpi siirtotie, mikäli käytettävällä yhteydellä aiheutuu virheitä. Tässä virheeksi katsotaan myös kellosignaalin häipymä, joka aiheuttaa irtoamista vaihelukituksesta.

Keksintö koskee menetelmää digitaalisen tiedonsiirron rinnakkaisen kellosignaalien vaihtamiseksi. Keksinnön mukaisesti pyydetään kellosignaalien vaihtoa vaihtolaitteesta ohjaussignaalilla, joka perustuu vaihelukitun silmukan antamaan lukituksen epävarmuutta osoittavaan signaaliin, odotetaan samanaikaista signaalikuvioita "11" eli samaa tilaa, jotta signaalit olisivat samassa aktiivissa vaiheen osassa, sekä signaalien vaihe-eron polariteetin käänymistä, jotta signaalit olisivat juuri olleet vaiheeltaan samat tai 180° vaihesiirrossa, ja viiveen DL jälkeen vaihdetaan kellosignaalileja, jolloin vaihto tapahtuu vaihdettavien kellosignaalien mahdollisimman samanvaiheisen hetken aikana.

Keksintö koskee sisäyksikköä, joka on digitaalista tiedonsiirtoa ja digitaalisen tiedonsiirron rinnakkaisen kellosignaalien vastaanotettavan kellosignaalin vaihtamista varten. Keksinnön mukaisesti sisäyksikköön kuuluu vaihtolaite etenemisvarmenneksen kellosignaalin vastaanottamiseksi ja vaihtamiseksi lukituksen menetyksen perusteella.

Keksintö koskee ulkoiksikköä, joka on digitaalista tiedonsiirtoa ja digitaalisen tiedonsiirron rinnakkaisten kellosignaalien vaihtamista varten. Keksinnön mukaisesti ulkoiksikköön kuuluu siirrettävän kellosignaalin lähetin sekä vastaavasti kellosignaalin vastaanottava vastaanotin ja vastaanotettuun kellosignaaliin tahdistuva vaihelukko sekä edelleen tahdistuksen tilan osoittavan signaalin anto sisäyksikölle.

Keksintö koskee järjestelyä digitaalisen tiedonsiirron rinnakkaisten kellosignaalien vaihtamiseksi, johon järjestelyyn kuuluu ensimmäinen sisäyksikkö lähetettävien kellosignaalien jakamista varten, antennit rinnakkaisten kellosignaalien lähetämistä ja vastaanottamista varten ja toinen sisäyksikkö vastaanottettavien kellosignaalien valitsemista varten. Keksinnön mukaisesti siihen lisäksi kuuluu

- ensimmäinen vaihtolaite ensimmäisessä sisäyksikössä ja toinen vaihtolaite toisessa sisäyksikössä etenemisvarmennetun kellosignaalin vastaanottoa varten, ja
- siirtoteillä ensimmäinen ja toinen ulkoiksikkö siirrettävän kellosignaalin lähetävällä lähettimellä sekä vastaavasti kellosignaalin vastaanottavalla vastaanottimella ja vastaanotettuun kellosignaaliin tahdistuva vaihelukko.

Keksinnön mukaisesti siirtotien vaihto suoritetaan aina kun kellosignaalin vastaanotto huononee niin paljon, ettei kellosignaaliin vaihelukittu silmukka pysy vaiheessa.

Vaihtolaite on toteutettavissa täysin sovelluskohtaisella integroidulla piirillä (ASIC, Application Specific Integrated Circuit).

Keksinnön etuna on pienemmän komponenttien lukumäärän ansiosta pienempi vika-
taajuus (MTBF, Mean Time Between Failure).

Keksinnön edullisia suoritusmuotoja on esitetty epäitsenäisissä patenttivaatimuksissa.

Seuraavassa eksintöä selostetaan yksityiskohtaisesti viittaamalla oheiseen piirustukseen, jossa

kuvio 1 esittää lohkokaaviota erästä eksinnön mukaisesta käyttöympäristöstä,

kuvio 2 esittää vuokaaviota erästä eksinnön mukaisesta menetelmästä,

kuvio 3 esittää lohkokaaviota erästä eksinnön mukaisesta linkkijärjestelystä,

kuvio 4 esittää lohkokaaviota erästä tunnetusta signaalin vaihtolaitteesta,

kuvio 5 esittää lohkokaaviota eräästä vaihtolaitteesta, jossa käytetään keksinnön mukaista kellosignaalin kanavointilaitetta,

kuvio 6 esittää lohkokaaviota eräästä keksinnön mukaisesta kellosignaalin kanavointilaitteesta,

5 kuvio 7 esittää lohkokaaviota eräästä toisesta keksinnön mukaisesta kellosignaalin kanavointilaitteesta, ja

kuvio 8 esittää lohkokaaviota eräästä kolmannesta keksinnön mukaisesta kellosignaalin kanavointilaitteesta.

Kuviota 1 on käsitelty edellä tunnetun tekniikan osiossa.

10 Kuviossa 2 esitetään vuokaaviossa erään keksinnön mukaisen menetelmän toimintavaiheita. Siirrettävä tietovirta jaetaan kahteen lähetykseen ja valitaan ensisijainen siirtotie eli oletustie 21. Siirretään kellosignaali 22 molemmilla siirtoteillä esimerkiksi radioyhteydellä. Vastaanotettaessa kellosignaaleja tutkitaan 23 molemmilla signaaliteillä kellosignaaliin vaihelukitun silmukan toimintavarmuutta. Jos 24 vaihelukitun silmukan toimintavarmuus on riittävä, käytetään 26 valitun siirtotien kellosignaaliin lukittua vaihelukkoo. Jos 24 vaihelukitun silmukan toimintavarmuus ei ole riittävä, vaihdetaan 25 valittu kellosignaalin siirtotie siirtymällä käyttämään toisen siirtotien kellosignaaliin lukittua vaihelukkoo. Kellosignaali kuitenkin lähetetään molemmilla siirtoteillä.

15 20 Kuviossa 3 esitetään lohkokaavio erään keksinnön mukaisen linkkijärjestelyn oleellisista osista. Sisäyksikkö (IU, Indoor Unit) 31 käsitteää vaihtolaitteen (CD, Changeover Device) 32 etenemisvarmennetun tiedon vastaanottoa varten. Ensimmäinen siirtotie käsitteää ulkoyksikön (OU, Outdoor Unit) OU1 33, antennit 34, 35 ja ulkoyksikön OU1 36. Siirtoteille yhteisenä oikealla nähdään sisäyksikkö IU 37 ja sen 25 käyttämä vaihtolaite CD 38. Toinen siirtotie käsitteää vastaavat laitteet 39, 40, 41, 42. Vasemmalta oikealle tapahtuvan siirron siirtotien valinta suoritetaan vaihtolaitteella 38 ja oikealta vasemmalle tapahtuvan siirron siirtotien valinta suoritetaan vaihtolaitteella 32. Ulkoyksiköt 33, 36, 39, 42 käsittevät välineet 33A, 36A, 39A, 42A kellosignaalin vastaanoton tahdistuksen tilan osoittavan signaalin muodostamis-30 ta ja antamista varten.

Kuviossa 4 esitetään eräs tunnetun tekniikan mukainen vaihtolaite, jossa vaihdetaan kahden kellosignaalin CLK ja datasignaalin DATA paria. Katkoviivoilla 41 rajoitetut osat on toteutettu sovelluskohtaisella digitaalisella integroidulla piirillä (ASIC,

Application Specific Integrated Circuit) ja niihin kuuluvat seuraavat osat: ensimmäisen signaaliparin CLK1, DATA1 vastaanottava joustava puskuri ELASTIC BUFFER 1, toisen signaaliparin CLK2, DATA2 vastaanottava joustava puskuri ELASTIC BUFFER 2, vertauskellosignaalin kanavointilaite REF MUX 44 sekä korrelaattori ja kanavointilaite CORR & MUX 47. Integroidun piirin ulkopuolella tarvitaan ainakin analoginen alipäästösuođatin (LPF, Low Pass Filter) 45 ja jänniteohjattu värähtelijä (VCO, Voltage Controlled Oscillator) 46. Aktiivin puskurin 42 tai 43 kirjoitus- ja lukuosoitteiden eroavaisuus johdetaan kanavointilaitteella REF MUX 44 suodattimelle 45 jänniteohjatun värähtelijän 46 ohjaamista varten.

5 10 Puskureihinkirjoitus ajoitetaan tulevilla kellosignaaleilla CLK1, CLK2 ja luku ajoitetaan jänniteohjatun värähtelijän 46 antosignaalla CLK, joka on lukittu aktiivin johdon kellosignaaliin CLK1 tai CLK2 puskurilta saatavalla tiedon kirjoituksen ja luvun aikaeron signaalla. Vastaanotettava johto päättää korrelaattorissa 47 ja muodostetaan ohjaussignaalit CONTROL1, 2 puskurien lukemista ja ohjaussignaali 15 CONTROL3 kanavointilaitteen ohjausta varten.

20 Kuviossa 5 esitetään erään keksinnön mukaisen signaalin vaihtolaitteen lohkokaavio sovelluskohtaisessa integroidussa piirissä. Vastaanotettavien signaaliparien kellosignaalit CLK1, CLK2 johdetaan kellosignaalin kanavointilaitteelle CLK MUX 51, jolla valitaan vastaanotettava kellosignaali CLK. Sekä kellosignaalit CLK1, CLK2 25 että datasignaalit DATA1, 2 johdetaan myös tietokehyksen purkulohkoihin 52, 53, joissa signaaleista muodostetaan esimerkiksi synkronointi SYNC-, bittivirhe BE (Bit Error)-, kehyksen kohdistuksen varoitus (FAA, Frame Alignment Alarm)- ja pseudokehyksen PF (Pseudo Frame) -signaalit sekä kehyksistä puretut datasignaalit DATADF1, DATADF2. Ulkoyksikkö OU aktivoi PF-signaalin menettäessään vastaanotettavan kellosignaalin CLK1, CLK2 lukituksen. Tällöin siirrettävä datasignaali korvataan ennalta määritellyllä kehysrakenteella. PF-signaalilla osoitetaan ennen FAA-signaalia kellosignaalin CLK1, CLK2 vastaanoton virhetilanteen sisäyksikössä, FAA-signaali aktivoidaan vasta usean vastaanotetun kehyksen kohdistusvirheen perusteella. Pseudokehysrakenteen ansiosta ulkoyksikön OU ja sisäyksikön IU 30 välinen tietoliikenne kyetään pitämään toimivana, vaikka ulkoyksikkö ei saa kunnollista kellosignaalia. Signaalit johdetaan joustavien puskureiden ja ohjausien lohkoihin EB & CTRL (EB, Elastic Buffer) 54, 55, joihin myös johdetaan valittu vastaanotettava kellosignaali CLK tiedon ajoittamista varten. Lohkoista 54, 55 johdetaan datasignaalit D1, D2 datasignaalien kanavointilaitteella DATA MUX 56 signaalina D purkulohkoon 57. Kanavointilaitetta 56 ohjataan purkulohkolla 57 signaalilla SYNC.

Kuviossa 6 esitetään keksinnön erään toteutusmuodon mukainen kellosignaalin kanavointilaite, jolla odotetaan sopivaa kellosignaalien vaihetta signaalien vaihtamista varten ja vaihdetaan signaalit. Signaalien kuvion "11" havaitseva lohko 61 antaa aktiivin signaalin, kun molemmat kellosignaalit CLK1, CLK2 ovat arvoltaan yksi.

5 5 D-kiikkupiirit 62, 63, 64 muodostavat vaiheen siirtymään reagoivan kytkennän, jossa annot johdetaan signaalien kuviot "01" ja "10" havaitsevaan lohkoon 65. Lohkon 65 anto nostetaan tämän kytkennän ansiosta arvoon yksi toisen kellosignaalin CLK2 yhden kellojakson ajan kuluttua hetkestä, jolloin kellosignaalien CLK1, CLK2 välisten vaihe-eron polariteetti on vaihtunut. Täten vaihe-ero on lohkon 65 annon nou-
10 suhetkellä lähes olematon tai 180° . Jos signaalit ovat samassa vaiheessa, voidaan ne vaihtaa keskenään lähes vaihesiirrotta pienen viiveen DL 66 jälkeen. Kellosignaalien vaihtoa kanavointilaitteella 68 ohjataan vaihdon kriteerit tarkastavalla lohkolla 67, joka saa ottosignaaleinaan vaihtoa pyytävän ohjaussignaalin, kellosignaalien kuvion "11" osoittavan signaalin ja kellosignaalien vaiheen käänymisen osoittavan
15 15 viiveellä DL viivästetyn signaalin. Näiden kriteerien perusteella tiedetään, että signaalit ovat samassa vaiheessa eivätkä 180° asteen vaihesiirrossa. Viiveen DL tarkoitus on varmistaa, että kellosignaalien vaihto suoritetaan kellosignaalien ollessa vaihtohetkellä järjestelmän kannalta staattisessa tilassa eli tilassa yksi. Tämä estää häiriöjännitepiikin syntymisen.

20 20 Kuviossa 7 esitetään eräs toinen keksinnön mukainen kellosignaalin vaihtolaite, johon kuuluu kuvion 6 esittämän ratkaisun lisäksi vaihdon ajoittava toisen kellosignaalin CLK2 taajuuden nelinkertaistava analoginen vaihelukittu silmukka 71 (APLL, Analog Phase-Locked Loop). Silmukan 71 anto johdetaan vaihdon kriteerit tarkastavalle lohkolle 67. Kuviossa 6 esitettyä viivettä DL ei tässä tarvita APLL:n käytön ansiosta, sillä vaihtotila on viivästettävissä käyttämällä taajuudeltaan nelinkertaistetun signaalin myöhempää vaihetta.

25 25

Kellosignaalien kuvion "11" osoittava lohko 61 on toteutettavissa esimerkiksi AND-portilla. Kuvion "01" tai "10" osoittava lohko 65 on toteutettavissa esimerkiksi XOR-portilla. Kuvion "10" osoittava lohko 86 on toteutettavissa esimerkiksi inverterillä ja AND-portilla.

Kuviossa 8 esitetään eräs kolmas keksinnön mukainen kellosignaalin vaihtolaite, jossa signaalien välinen vaihe-ero todetaan enintään viiveen DL suuruisen aikaeron vallitessa. Kellosignaalin CLK1 ollessa vähän kellosignaalialta CLK2 edellä välittyy D-kiikkujen 81, 82 antitiloiksi yksi, mutta vaihe-eron kuitenkin alittaessa viiveen 83 DL ajan välittyy D-kiikkujen 84, 85 antitiloiksi nolla. Tällöin signaalien katsotaan olevan riittävän tarkasti samassa vaiheessa ja vaiheilmaisin 86 saa ottoinaan D-

kiikkujen 82, 85 antosignaalit tiloissa yksi ja nolla sekä antaa antonaan signaalin yksi. Analoginen vaihelukittu silmukka 71, vaihdon kriteerit tarkastava lohko 67 ja kanavointilaite 68 toimivat muuten samoin kuin kuvioiden 6 ja 7 tapauksissa, mutta lohko 67 huomioi vain silmukan 71, vaiheilmaisimen 86 ja ohjaussignaalit.

5 Toisiaan edellä esitetyissä kuvioissa 6, 7 ja 8 vastaavat osat on merkitty samoilla viitenumeroilla asian selventämiseksi.

Tarkastellaan esimerkkinä erästä keksinnön mukaista etenemisvarmennettua radio-linkkiä, jossa virheenkorjausmenetelmänä käytetään RS (63, 59) -algoritmiä.

10 Molemmilla siirtoteillä ulkojyksiköissä OU1, OU2 lasketaan tarkasteluvälin pituisen tietovirran tarkistussumma (check sum) kertomalla tarkasteltava tieto RS (63, 59) -primitiivipolynomilla. Tarkistussumma lisätään tarkasteltavan tiedon perään. Tarkasteluväli on tässä 354 bittiä eli 59 tavua pitkä, kun tavu on 6-bittinen. Tarkasteluvälin sisältämän hyötytiedon ja tarkistussumman muodostaman tietokehyksen pituus on 378 bittiä eli 63 tavua, josta tarkistussumman osuus on 4 tavua.

15 Muodostetut tietokehykset siirretään tässä kahta eri radiotietä, jotka ovat mahdollisimman eri tavoin alttiita häiriöille. Täten mahdolliset häiriöt aiheuttavat virheitä yleensä vain yhdelle siirtotieelle kerrallaan.

Vastaanotetut tietokehykset käsitellään vastaanottavissa ulkojyksiköissä OU1, OU2 jakamalla siirretty tietokehys generaattoripolynomilla, jolloin saadaan jakojäännös.

20 Virheitä paikantava algoritmi käyttää jakojäännöstä virheiden havaitsemiseen. Virheiden havaitsemisen lisäksi virheitä kyetään korjaamaan tässä tapauksessa korkeintaan kaksi virheellistä tavua. Korjattavien tavujen suurin määrä on nostettavissa limityksellä (interleave) kahdeksaan tavuun asti. Tavut korjataan ja lasketaan virheluku, joka osoittaa, kuinka monta virhettä vastaanotetussa tiedossa oli. Ulkojyksiköissä OU1, OU2 muodostetaan tietokehys, joka sisältää korjatun hyötytiedon sekä virheluvun.

Sisäyksikkö IU vastaanottaa molemmilta ulkojyksiköiltä OU1, OU2 tietokehyksen ja vaihtolaite CD valitsee virheluvun perusteella paremman siirtotien hyötytiedon johdettavaksi edelleen antojohdolle.

30 Keksintöä voidaan käyttää esimerkiksi plesiokronisen digitaalisen hierarkian (PDH, Plesiochronous Digital Hierarchy) mukaisten radioverkkojen linkkien varmentamiseen. Tällöin esimerkiksi GSM-verkon radiolinkkien taajuudet vaihtelevat välillä 7 - 38 GHz, ja jopa 58 GHz on mahdollinen. Tällaisessa sovelluksessa hyötysignaali on

plesiokronisen digitaalisen hierarkian (PDH, Plesiochronous Digital Hierarchy) datasaali, jonka nopeus on yleensä 2 Mbit/s tai sen parillinen monikerta, mutta voi olla myös ainakin 34 Mbit/s. Linkin pituus on sadasta metristä jopa useisiin kymmeniin kilometreihin asti.

5 Signaalin aktiivilta tilalla tarkoitetaan tässä, että signaalin kriteerit täytyvät. Siis signaalin tila on tosi tai edullisesti yksi. Signaalien tilat voidaan myös käännyttää, jolloin tilan "11" sijasta tarkkaillaan tilaa "00". Samalla tilalla tarkoitetaan kuitenkin tiloja "11" tai "00" ja eri tiloilla tiloja "01" tai "10".

10 Sisä- ja ulkoyksiköllä tarkoitetaan yksikön kuvaannollista asemaa järjestelmässä, eikä rajoiteta yksikön sijoittamista rakennuksen sisä- tai ulkotiloihin.

Siirtoteitä voi olla kaksi tai useampia.

Keksintöä ei rajata pelkästään edellä esitettyjä sovellutusesimerkkejä koskevaksi, vaan monet muunnokset ovat mahdollisia pysytäessä patenttivaatimusten määrittelemän keksinnöllisen ajatuksen piirissä.

Patenttivaatimukset

1. Menetelmä digitaalisen tiedonsiirron rinnakkaisen kellosignaalien vaihtamiseksi, **tunnettua** siitä, että
 - pyydetään (25) kellosignaalien vaihtoa vaihtolaitteesta ohjaussignaalilla, joka perustuu vaihelukitun silmukan antamaan (23) kellosignaalalin vastaanoton lukituksen epävarmuutta osoittavaan signaaliin,
 - odotetaan (25), että kellosignaalit olivat tietyssä samassa tilassa,
 - odotetaan (25) signaalien vaihe-eron polariteetin käänymistä, jotta signaalit olisivat juuri olleet vaiheeltaan samat tai 180° vaihesiirrossa, ja
- 5 - viiveen DL jälkeen vaihdetaan (25) kellosignaaleja, jolloin vaihto tapahtuu vaihdettavien kellosignaalien mahdollisimman samanvaiheisen hetken aikana.
- 10 2. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettua** siitä, että
 - pyydetään (25) kellosignaalien vaihtoa ohjaussignaalilla (CONTROL) vaihtolaitteesta ohjaussignaalilla, joka perustuu vaihelukitun silmukan antamaan (23) lukituksen epävarmuutta osoittavaan signaaliin,
 - annetaan (25) kellosignaalien saman tilan havaitsevalla lohkolla havaintosignaali, kun molemmat kellosignaalit (CLK1, CLK2) ovat samassa tilassa,
 - muodostetaan (25) vaiheen siirtymään reagoivalla kytkenällä kellosignaalien eri tilan havaitsevalle lohkolle vaihe-eron polariteetin vaihtumisen osoittava signaali,
- 15 20 - lähetetään (25) viivästetysti vaihe-eron polariteetin vaihtumisen osoittava signaali vaihdon kriteerien toteutumisen tarkastavalle lohkolle, kun havaitaan, että kellosignaalit ovat eri tiloissa,
- ohjataan (25) kanavointilaite vaihtamaan kellosignaalit ainakin ohjaussignaalilin (CONTROL), kellosignaalien saman tilan havaintosignaalin ja viivästettävän vaihe-eron polariteetin vaihtumisen osoittavan signaalin ollessa aktiivisia ohjaussignaalilin (CONTROL) osoittamaan tilaan.
- 25 30 3. Sisäyksikkö (31, 37) digitaalista tiedonsiirtoa ja digitaalisen tiedonsiirron rinnakkaisen kellosignaalien vaihtamista varten, **tunnettua** siitä, että sisäyksikköön kuuluu vaihtolaite (38) kellosignaalalin vastaanottamiseksi ja vaihtamiseksi kellosignaalalin vastaanoton lukituksen menetyksen perusteella.

4. Patenttivaatimuksen 3 mukainen sisäyksikkö, **tunnettu** siitä, että vaihtolaite (38) on toteutettu sovelluskohtaiseen integroituun piiriin ja siihen kuuluu

- kellosignaalien kanavointilaite (51) vastaanotettavien signaaliparien kellosignaalien (CLK1, CLK2) valintaa varten vastaanotettavaksi kellosignaaliksi (CLK) odottamalla sopivaa kellosignaalien vaihetta signaalien vaihtamista varten ja suorittamalla vaihto,

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- ainakin kaksi tietokehyksen purkulohkoa (52, 53), joissa kellosignaaleista (CLK1, CLK2) ja datasignaaleista (DATA1, DATA2) muodostetaan ohjaussignaalit ja kehyksistä puretut datasignaalit (DATADF1, DATADF2),

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- ainakin kaksi joustavan puskurin ja ohjauksen lohkoa (54, 55), joissa ohjaussignaaleilla ja puretuilla datasignaaleilla (DATADF1, DATADF2) muodostetaan vastaanotettavalla kellosignaalilla (CLK) ajastetut datasignaalit (D1, D2),
- datasignaalien kanavointilaite (56) vastaanotettavan datasignaalin (D) valitsemista varten ohjaussignaalilla (SYNC) ohjaamalla, ja

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- purkulohko (57) vastaanotettavan datasignaalin (D) vastaanotettavalla kellosignaaliilla (CLK) lopulliseksi datasignaaliksi (DATA) ajoittamista ja datasignaalien kanavointilaitteen (56) ohjaamista ohjaussignaalilla (SYNC) varten.

5. Patenttivaatimuksen 3 tai 4 mukainen sisäyksikkö, **tunnettu** siitä, että sisäyksikkö (31, 37) on matkaviestinliikenteen radiolinkin osa.

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6. Ulkoyksikkö (33, 36) digitaalista tiedonsiirtoa ja digitaalisen tiedonsiirron rinnakkaisten kellosignaalien vaihtamista varten, **tunnettu** siitä, että ulkoyksikköön kuuluu siirrettävän kellosignaalin lähetävä lähetin sekä vastaavasti kellosignaalin vastaanottava vastaanotin ja vastaanotettuun kellosignaalilin tahdistuva vaihelukko sekä edelleen välineet (33A, 36A) tahdistuksen tilan osoittavan signaalin antoon.

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7. Patenttivaatimuksen 6 mukainen ulkoyksikkö, **tunnettu** siitä, että ulkoyksikkö on matkaviestinliikenteen radiolinkin osa.

8. Järjestely digitaalisen tiedonsiirron rinnakkaisten kellosignaalien vaihtamiseksi, johon järjestelyyn kuuluu ensimmäinen sisäyksikkö (31) lähetettävien kellosignaalien jakamista varten, antennit (34, 35, 40, 41) rinnakkaisten kellosignaalien lähetämistä ja vastaanottamista varten ja toinen sisäyksikkö (37) vastaanotettavien kellosignaalien valitsemista varten, **tunnettu** siitä, että siihen lisäksi kuuluu

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- ensimmäinen vaihtolaite (32) ensimmäisessä sisäyksikössä (31) ja toinen vaihtolaite (38) toisessa sisäyksikössä (37) etenemisvarmennetun kellosignaalin vastaanottoa varten, ja

5 - ensimmäinen (33) ja toinen (36) ulkoyksikkö, jossa on siirrettävän kellosignaalin lähetävä lähetin sekä vastaavasti kellosignaalin vastaanottava vastaanotin ja vastaanotettuun kellosignaaliin tahdistuva vaihelukko.

9. Patenttivaatimuksen 8 mukainen järjestely, **tunnettu** siitä, että vaihtolaite (38) on toteutettu sovelluskohtaiseen integroituun piiriin ja siihen kuuluu

10 - kellosignaalien kanavointilaite (51) vastaanotettavien signaaliparien kellosignaali-10en (CLK1, CLK2) valintaa varten vastaanotettavaksi kellosignaaliksi (CLK) odot-15tamalla sopivaa kellosignaalien vaihetta signaalien vaihtamista varten ja suorittamalla vaihto,

15 - ainakin kaksi tietokehyksen purkulohkoa (52, 53), joissa kellosignaaleista (CLK1, CLK2) ja datasignaaleista (DATA1, DATA2) muodostetaan ohjaussignaalit ja ke-15hyksistä puretut datasignaalit (DATADF1, DATADF2),

- ainakin kaksi joustavan puskurin ja ohjauslohko (54, 55), joissa ohjaussignaa-15leilla ja puretuilla datasignaaleilla (DATADF1, DATADF2) muodostetaan vastaan-17ottavalla kellosignaalilla (CLK) ajastetut datasignaalit (D1, D2),

20 - datasignaalien kanavointilaite (56) vastaanotettavan datasignaalin (D) valitsemista varten ohjaussignaalilla (SYNC) ohjaamalla, ja

- purkulohko (57) vastaanotettavan datasignaalin (D) vastaanotettavalla kellosig-20naalilla (CLK) lopulliseksi datasignaaliksi (DATA) ajoittamista ja datasignaalien kanavointilaitteen (56) ohjaamista ohjaussignaalilla (SYNC) varten.

25 10. Patenttivaatimuksen 9 mukainen järjestely, **tunnettu** siitä, että ohjaussignaa-25leihin kuuluu synkronointi SYNC-, bittivirhe BE-, kehyksen kohdistuksen varoitus (FAA, Frame Alignment Alarm)- ja pseudokehyksen PF-signaalit.

11. Patenttivaatimuksen 9 mukainen järjestely, **tunnettu** siitä, että kellosignaalien kanavointilaitteeseen (51) kuuluu

30 - kellosignaalien saman tilan havaitseva lohko (61), joka antaa aktiivin signaalin, kun molemmat kellosignaalit CLK1, CLK2 ovat samassa tilassa,

- D-kiikkupiirit (62, 63, 64), jotka muodostavat vaiheen siirtymään reagoivan kyt-kennän,
- kellosignaalien eri tilan havaitseva lohko (65), johon johdetaan vaiheensiirtymään reagoivan kytkennän annot ja jonka lohkon (65) anto nostetaan tämän kytkennän 5 ansiosta arvoon yksi toisen kellosignaalalin CLK2 yhden vaiheen ajan kuluttua het-kestä, jolloin kellosignaalien CLK1, CLK2 välisen vaihe-eron polariteetti on vaihtu-nut,
- viivepiiri (66) kellosignaalien eri tilan havaitsevan lohkon (65) antosignaalin vii-västämiseksi,

10 - kellosignaalin vaihdon kriteerit tarkastava lohko (67) vaihdon pyynnön ohjaussig-naalin, kellosignaalien saman tilan havaitsevan lohkon (61) antosignaalin ja viive-piirin (66) antosignaalin tilan tarkastamista varten, ja

- kanavointilaite (68) kellosignaalien vaihtoa varten kriteerit tarkastavan lohkon (67) ohjaamana, jolloin kellosignaalien vaihe-ero on lähes olematon.

(57) Tiivistelmä

Uusi varmennetun tiedonsiirtolinkin rinnakkaisten siirtoyhteyksien kellosignaalien vaihtojärjestely. Keksinnön mukaisella tavalla vastaanotettava siirtotie vaihdetaan ennen vaihelukituksen menetystä ja linkin tiedonvälitys säilyy virheettömänä, mikäli edes toinen siirtoteistä välittää kellosignaalin riittävän virheettömänä, vaikka toisesa aiheutuu virheitä. Tämä toteutetaan lähetämällä siirtoteille yhteisen sisäyksikön (IU, Indoor Unit) jälkeisillä rinnakkaisilla ulkoyksiköillä (OU, Outdoor Unit) kellosignaali, vastaanottamalla se vastaavilla toisilla ulkoyksiköillä, joissa lukitutaan vaihelukituilla silmukoilla signaaliin ja annetaan toiselle sisäyksikölle tietoa vaiheen lukituksen tilasta, sekä valitsemalla vastaanottavassa sisäyksikössä ulkoyksiköstä annetun tilatiedon perusteella virheettömämpi siirtotie, mikäli käytettävällä yhteydellä aiheutuu virheitä. Tässä virheeksi katsotaan myös kellosignaalin häipymä, joka aiheuttaa irtoamista vaihelukituksesta.

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